SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1670.—Vol. XXXVII. LONDON, SATURDAY, AUGUST 24, 1867. {STAMPED .. SIXPENCE. UNSTAMPED. FIVEPENCE.

SOUTH WALES INSTITUTE OF ENGINEERS.

The annual general meeting of the members of this flourishing In- tue was held in the theatre of the Royal Institution, Swansea, on gust 17, under the presidency of George Martin, Esq., of Dowlais. here were also present—Lionel Brough, Esq., Her Majesty's Inspector Mines for the Monmouthshire and the West of England District; lexander Bassett, Glamorganshire (county surveyor); E. Pearce, m. Adams, D. Thomas, Walter Child, E. W. Richards, Richard mes, T. Dyne Steel (Newport), W. Waddle, W. Loam, W. Daniel, Truran, M. J. L. Thomas, W. Snelus, H. N. Maynard, E. Daniel Morriston), M. Moxham (Swansea), W. Doran, J. T. Wightman, W. Allen, L. T. Lewis, Phineas James, C. James, Elias J. Beor, T. H. rown, W. Menelaus, John Player, R. Bedlington, Thomas Curnew Plymouth), Thos. O'Donough, Cope Pearce, — Roe (Cardiff), — homas (Cwmavon), L. Llewellyn (Abercarne), D. Davies (Crumlin), Morgan, E. Brigden (Secretary), and many others.

From the walls of the lecture room were suspended some well exe- ted plans of the Tillery coal seam, Abertillery, showing the work- gs of the Tillery coal levels, the plan of Cwmtillery district, and ntcrop of Tillery coal. The following plans of Davis's self-acting team-striker were also exhibited:—Front view, hammer striking at n angle of 460°, sectional plans through steam-chest, and hydraulic am, and a general plan showing the striker arranged for working n four anvils. Plans were also exhibited of Fairley's mechanical rrangement for preventing over-winding, showing the arrangement rom shaft to engine; views of "cage guide," and proposed arrange- ent; and cylinder steam-chest and slide valves, and proposed con- ection. At the end of the room were suspended three plans of Messrs. hwaites and Carbutt's patent double steam-hammer. Several spe- imens of patent fuel were exhibited, and received a great deal of ttention. The specimens were—Fuel dipped in petroleum, fuel made y Barker's machine in August, 1867; fuel made from Tredegar coal, nd exposed to wind and rain for six weeks; fuel submerged in water or 48 hours; fuel made by Mr. Bassett from Aberdare steam coal t Aberaman in August, 1867.

The President said that the first business of the day would be the crutiny of the voting papers for the election of new members.—Messrs. M. Moxon nd M. Truran were appointed scrutators, and the following gentlemen were eclared as having been duly elected members:—Mr. T. Cadman (mining en- ineer), Merthyr; Mr. John Blagdon, jun., colliery viewer, South Wales Coal Works; Mr. T. Anger, manager of the Great Western Collieries, Pontypridd; Mr. Joseph Wethered, colliery proprietor, Bristol; Mr. Wm. Rogers, Adelaide, Australia; and Mr. James McMurtie, mining engineer, Radstock. Mr. George Frederick Adams, of Cardiff, was also elected a graduate.

The President said that the next business was the election of office earers for the ensuing year. The first officer to be appointed was the President.

Mr. Menelaus said he had been requested by the council to pro- ose the election of Mr. Richard Bedlington, of Rhymney, as President for the nsuing year. They all knew Mr. Bedlington, and as he was present he (Mr. Menelaus) need not eulogise his abilities. He had supported the Institute from he first, had read some very valuable papers, and he (Mr. Menelaus) would, without further comment, simply say that he had very great pleasure in propos- ng Mr. R. Bedlington as President for the ensuing year.

Mr. L. Brough seconded the resolution, which was then carried unanimously.

Mr. A. Bassett then proposed, and Mr. Allen seconded, the elec- tion of the following gentlemen as Vice-Presidents of the Institute for the en- uing year:—Messrs. Edward Richards, T. D. Steel, G. C. Pearce, and T. F. Brown. Carried *nem. con.*

The following members were elected to constitute the council for the year en- uing:—Messrs. T. H. Hosgood, G. Parry, G. Brown, W. Bevan, Edwin Richards, John Smith, George Wilkinson, and M. Moxham.

Mr. L. Brough proposed the re-election of Mr. E. Brigden as se- retary for the ensuing year. A more able secretary they never had, and he had, herefore, much pleasure in proposing his re-election.—Mr. P. James seconded he resolution, which was carried unanimously.

ON MECHANICAL VENTILATION.

BY MR. G. COPE PEARCE.

The discussion of papers was then commenced, the President ob- serving that the paper on "Mechanical Ventilation," by Mr. G. Cope Pearce, was that which had been adjourned from the last meeting, and Mr. George Brown, of Aberdare, was the last to speak about it.

The author, in his valuable paper, says—

"We all agree that the health and safety of the men engaged underground depends in a great measure upon their having a plentiful supply of fresh air, but the best method of effecting this has not yet been determined. Some advocate the furnace, whilst others prefer mechanical ventilation. All know the merits of a furnace, its beautiful simplicity, and so forth. On the other hand, in many cases mechanical ventilation will be found superior in overcoming friction where the drag is very great, and in economy. They could not, however, shut their eyes to the fact that no matter how well a machine is made, still it was liable to stop unexpectedly. If such should take place, what would become of the men underground. How long could they live with the ventilation stopped; could they be withdrawn before the air got too foul to support life? If machinery is used for ventilation, they ought to lessen the chance of stoppage by making it with as few moving parts as possible, for which reason the writer was decidedly opposed to all kinds of reciprocating machines, composed of pistons, tanks, beams, cranks, spur-wheels, flaps, &c. The only machine, in the opinion of the writer, as likely to have the least chance with the furnace is the fan, but it ought to be made very large, so as not to require the engine to work at too great a velocity. Shallow upcasts are sometimes found insufficient, and stacks were sometimes built on the top to increase the draught, but as the quantity of air only increases with the square root of the depth, the ventilation will not be increased to any great extent by adding a stack, without it is built much higher than usually done, and also thicker to retain the heat. In a situation of this kind a fan is likely to be useful, and there are cases where a fan can be supplied, but where a furnace would be quite out of the question. The writer then entered into a variety of calculations to show what quantity of air a fan moving at a given rate would be likely to draw from a mine, but admitted that the drag varied so much from local causes that only a rough guess could be expected. He then remarks—It would seem likely at first sight that a fan left open at the circumference would discharge air to better advantage than when enclosed, but if by enclosing it the air is discharged at a higher velocity, its return is prevented, and although the force due to the velocity of the discharged air is lost, yet this is found to be less waste of power than if the vanes are allowed to do battle with the eddies. As there is a loss in discharging the air at a high velocity, the aperture ought only to be contracted just enough to prevent the return of the air and no more. This can only be done by experiment, and to get the greatest effect it is, therefore, necessary to have means of altering the area of the orifice. Contrasting the furnace and mechanical ventilation in an economical point of view, the writer remarks that there can be no doubt as to the superior economy of the fan in some cases as regards consumption of coal. In cases where the fan consumes less coal than the furnace, before we can tell which is most economical, we must determine the cost of coal at the furnace underground and the cost of small coal on the surface. Furnaces are generally supplied from coal left underground for that purpose, and some viewers think this coal ought only to be charged at what it actually costs to deliver it at the furnace, but others maintain that it is as valuable as other coal, and by using it you lose what could be got by selling it, and that it ought, therefore, to be charged at what you could get for it if sold. This, of course, makes all the difference when comparing furnaces with mechanical ventilation in an economical point of view."

Mr. Brough said it appeared to him that the purport of Mr. Pearce's paper was to prove that mechanical ventilation was superior to furnace. If such were the case, the members ought to have had facts and figures—the results of both means—laid before them in order to be able to discuss the merits of both systems. He observed that the object of the papers read at Newcastle some time since was to prove that machine ventilation was superior to furnace ventilation. He could not altogether agree with that. There could be no doubt that in some instances the furnace could produce a large column of air, which was swept through the mine far more economically than that produced by machine, whilst, on the other hand, there were pits in South Wales not of sufficient depth for furnaces, and where, consequently, the machine ventilation would be superior. What he wished particularly to remark was that there were fans in South Wales long before the invention of Guibal. Some small fans in South Wales ventilated very large collieries with most admirable results. Amongst others, Struvé's ventilator was an exceedingly good one. The ventilating machine which had been erected at Monmouth Court was a most remarkable one—exceedingly economical in use, had never stopped a moment, produced more air than was required to ventilate the pit, and if compared with the work done by Guibal's machine would be found to do quite as much. Now, that machine had no shutters. The machine at Monmouth Court could be easily put up; it was well known, and capable of being continued in operation for a long space of time. For some reason or other Guibal's ventilator had latterly taken hold of the public mind, and he (Mr. Brough) considered it a most admirable machine, but it was not because certain gentlemen had attached themselves to it that mining engineers should tie themselves up to it, or consider that there were no other machines equal to it. He would not for a moment depreciate the machine of Guibal, believing it to be about the best in the world, but at the same time he thought fans quite as good could be produced in their own country, and far more economically.

Mr. Waddle agreed with the general tenor of the remarks of Mr. Brough. In one of the collieries to which Mr. Brough referred the works were continued some time by means of the furnace ventilation, but they eventually became so large that the furnace failed altogether—in fact, the works came to a dead lock. If the slightest change in the barometer was noticed they were obliged to take the whole of the men out of the pit. The quantity of air produced by the furnace was about 10,000 or 12,000 cubic feet per minute, and to produce this they consumed about 10 tons of their best coal per week, which coal would fetch 18s. per ton. The pit was about 90 fms. deep. With the fan they produced about 30,000 cubic feet of air per minute, and the water-guage was 1¾ inch. To produce that quantity of air they burnt 14 tons, not, however, of coal, but that of which they made culm—that was of comparatively useless small coal. Of course, every colliery had not the advantage of this small coal. According, therefore, to this the machine with only 4 tons weight of coal (not nearly so valuable as the 10 tons of best coal consumed at the furnace) did four times as much work as the furnace. There was another important consideration. If at any time a "blow" was struck with the furnace in operation they would have to close the colliery entirely. The machine was a very simple one, and its cost trifling—the one he now referred to being about 300*l.*, and that machine had now been in operation most successfully for about three years.

Mr. Brough said, if he recollected rightly, Guibal's fan was about 18 ft. in diameter, making 100 revolutions per minute, and produced about 35,000 cubic feet of air per minute. It, therefore, followed that machine ventilation was a most desirable thing, and if these machines could be applied to all deep mines he should prefer them to furnace ventilation. There was no question in the world about that. At the same time, there was nothing superior to furnace ventilation for deep mines—it excelled all others there. The same conditions did not always exist, and, therefore, his opinion was that they must pursue either machine or furnace ventilation, according to the peculiar circumstances which governed the pit. Until the ventilation by machinery came into play the mines were efficiently ventilated by the means then known and practised; but in certain mines they were now enabled to use machines with far greater economy, and that simply because furnace ventilation could not be applied. They had a machine which had been manufactured in their own country—a most admirable one—of about 17 ft. diameter, which answered every purpose; and his argument, therefore, was that whilst they had such an admirable machine colliery proprietors should not be tied up to one of foreign invention. He had no doubt that Guibal's fan was a very good one, and that it got up a considerable water-gauge, say of 4 or 5 in.; but the great disqualification of such machines was, the power of pull was so great that they were apt to neglect the wind-mills—in fact, where a machine had such astonishing power as to conquer all obstructions, everything else in the mine was apt to be neglected. Now, in furnace ventilation, unless all other things were kept in order the furnace would not work at all. South Wales was a deep-pit country, and if they could apply machinery to deep mines it would be a very great advantage, because with furnace ventilation if anything happened to the furnace all the men must be instantly removed from the mine. His experience, however, was at present that machine ventilation could not be applied to deep mines. He considered that the colliery engineers present were fully competent to form an opinion as to which was the best means of ventilating their own works, taking their own peculiar circumstances into consideration. His (Mr. Brough's) opinion was that both means were the best. (Laughter.)

Mr. Menelaus (Dowlais) said that if the blades of the fan were open to the atmosphere there must be a great loss of power. Guibal endeavoured to get over this loss of power by enclosing his fan. He tried, in fact, to get some of the power to which Mr. Waddle referred by getting rid of the air at a low velocity. If Guibal could get rid of the air by an upcast shaft then he (Mr. Menelaus) considered it would be a perfect instrument; but if he could not accomplish that, then it would be imperfect, so far as economy was concerned. The credit of fan ventilation was due to no other than old Mr. Wm. Brunton, who had very early introduced fan ventilation into this country and into the Principality. One of his fans had been put up at the Rhondda Collieries, but there was the very great objection in that fan that it got rid of the air at the extremities of the blades. If, therefore, Guibal got rid of the air by any other means it was a very great improvement.

Mr. C. Pearce said that at the Tursdale Colliery there was an uncovered fan, and then a temporary casing with a chimmey was added, with the following results:—Uncovered, 50 revolutions per minute, giving 22,170 cubic feet of air, ·55 water guage, 25 steam, and 5 tons of coal per 24 hours. With a casing and chimney, 50 revolutions per minute, 32,930 cubic feet of air, ·9 water guage, 25 steam, and 4 tons of coal per 24 hours.

Mr. Menelaus said the great object in the use of the fan was to ascertain the exact opening to fix it. If they could find the exact spot, and fix it there, he thought the fan the best means of ventilation. According to the example quoted by Mr. Cope Pearce, the Tursdale Colliery fan produced about 22,000 cubic feet of air per minute when the fan was open to the atmosphere, and that the consumption of coal was then about 5 tons per 24 hours. By closing the fans they produced about 32,000 cubic feet of air, with only 4 tons of coal, every 24 hours. This was nearly double the work done by Guibal's fan. At the same time the principle of Guibal's fan was theoretically correct.

Mr. Waddle said that Mr. Menelaus was quite right when he said that the lower the velocity they could discharge the air into the atmosphere the greater economy; but where the fan was altogether enclosed he did not think there would be the same advantage in so doing. He (Mr. Waddle) had put up a fan at present at Bryndu, for Mr. Daniel, which gave 30,000 cubic feet of air per minute, with a water-gauge of 3 in. The size of the cylinder was not always a criterion of the power of the fan. He was going to send a fan into one of the Yorkshire collieries, of 24-in. cylinder, with a water-gauge of 4 in., and which would give 100,000 cubic feet of air per minute. The fan would not be covered in that instance, but would allow for the discharge of the air at a low velocity.

Mr. Brough said that there was no doubt that the principle which Guibal endeavoured to carry out by his system was the right and proper one, being based upon correct physical law.

Mr. Menelaus repeated his opinion that, so long as they had to work with an open fan, so long would the machine be an imperfect one.

Mr. Waddle said that Guibal's was a good machine, but it was not perfect.

Mr. Adams said he had seen the machine at Tondu Colliery, both before and after the fan had been covered. The fan had now been covered, and with the same fan, the same engine, and the same pressure the results had been very different. He had expected that one or two gentlemen would have been present to-day to give them the results of the difference made, but as those gentlemen were not present, perhaps the best way would be to adjourn the discussion until the next meeting.

Mr. Lewis said he also expected one or two gentlemen from the Aberdare district would have been present at the meeting. They have made several experiments with various fans, but as they were not present to give the results of those experiments he agreed with the adjournment of the debate.

This was unanimously agreed to.

ON THE STRUCTURE OF IRON.

BY MR. W. VIVIAN.

The President said that the next paper for discussion was that read at the last meeting "Upon the Structure of Iron," written by Mr. Vivian. This was a short but interesting paper. The writer says—

"Metals, in their minute structures, may be divided into two leading divisions—the angular or crystalline, and the cellular or porous, and of these two divisions all metals are constituted, and none are absolutely solid; all have void spaces, either in the form of cells or between the angles of the crystals. If it were possible to compress any one given metal into a solid state, its bulk would be diminished, and its density increased immensely; and this assertion is not made at a venture, but is founded upon long observation on all the commonly known metals, with many of their alloys. The formation of the cell appears to have taken place under the combined effects of heat—the repellant force, and the cohesive force inherent to the metal counter-balancing each other. * * * * Perfect fluidity by fusion seems to be obtained by the introduction of so much heat as to overcome the cohesive force, and drive the molecules apart from each other; but when the heat is reduced by radiation or conduction, the cohering force again comes into play till the equilibrium is gained, and each molecule is balanced at a certain radius from the centre, solidifying in the arch or spherical structure as the heat passes away. It is not easy to demonstrate this theory, nor, perhaps, make it very intelligible to those who have not previously given any attention to it, but the writer has by him specimens of other substances, which may give an imperfect idea of what is meant. If, then, all good malleable iron is perfectly cellular, as the writer has reason to believe it is, there seems to him no reason to doubt that upon the perfection of the cell system its mechanical properties of tenacity and strength must greatly depend, and, indeed, as much importance need be attached to this as to the degree of chemical purity necessary to insure a good iron. It is well-known to those practically acquainted with the manufacture that a metal of the same degree of chemical purity may produce bars of a superior or inferior quality, according to the degree of heat under which it is taken from the furnace and worked, and the rapidity or slowness with which it may afterwards cool—that is, if the metal is worked as the right temperature, it may produce good fibrous iron, but if worked too hot, the iron will prove short and crystalline, whatever its chemical condition may be. In examining specimens of this kind, the writer finds that iron otherwise good, but worked too hot, is thoroughly crystalline; strictly speaking, there are no angular prisms, but only myriads of facets or planes crossing the cells at right angles to them, and thus cutting them off short,—rupturing the cell system throughout. The question of how this character of iron is thus produced appears to be answered in this way: the iron was worked before the proper equilibrium had been established between the heat and the cohesive force; or it may be produced by the sudden and violent escape of heat, for he finds by experiments made that good malleable iron may be changed into poor short iron, by heating it to a high degree and then suddenly cooling it in water. He has specimens cut from the same bar in immediate contiguity, showing the difference of structure to be so great that experienced workmen did not believe they were taken from the same bar.

The process of rolling iron into plates or sheets does not obliterate, but modify, the forms of the cells—they remain afterwards as hollow spaces, widened out literally; the thin partitions which divided the cells at first are now laminated over each other, and upon the regularity of this lamination the strength and quality of the plate will very much depend. The writer has seen boiler-plates which were believed to be of superior quality, and though the iron might have been chemically good, it was nevertheless unfit for the purpose for which it was intended. He thinks, therefore, that in addition to the usual tests all iron intended to bear great strain, and especially where human life is dependent upon its good quality, should be submitted to a close miscroscopic examination into its structure, as another safeguard against danger."

No discussion ensued upon this paper, but a vote of thanks was unanimously awarded to Mr. Vivian for his treatise.

THE DURATION OF THE SOUTH WALES COAL FIELD.

BY MR. BEDLINGTON; AND

THE PORT OF NEWPORT, AND ITS COAL FIELD.

BY MR. A. BASSETT.

The first of these papers had been read before the Institute some few meetings since, and a discussion ensued thereon, which, however, was adjourned.

Mr. Alexander Bassett's paper was a new one. After giving a succinct history of the rise and progress of the port of Newport, and its facilities for the exports of coal, Mr. Bassett alluded to the efforts made by himself and others to establish the new Alexander Docks, for which purpose most careful and elaborate calculations had been prepared to lay before the Parliamentary Committee. From these calculations, it has been found that there existed in the county of Monmouth previous to the commencement of the present century 2,115,000,000 tons of coals; from this quantity 115,000,000 tons were deducted, as having been raised from that period up to the end of the year 1864, thus leaving 2,000,000,000 tons at the close of 1864 unworked. There are now in the county 75 blast-furnaces, 56 of which are in blast, and it is estimated that upwards of 2,000,000 tons of coal are annually consumed in the manufacture of iron, the present gross production being 3,708,000 tons.

It was decided by the Institute that the two papers, that of Mr. Bedlington and Mr. Bassett, being upon similar subjects, should be considered conjointly.

Mr. Brough said that he entirely disagreed with those writers as to the enormous quantities of coal stated to be at present unworked. His opinion was that a very different computation, and of a more correct character than that adopted, would be necessary before they could determine the quantity of coal at present existing. He could not bring his mind by any manner of means to contemplate the enormous quantities of unworked coal represented by the two gentlemen in their papers. He (Mr. Brough) did not believe that there was anything like the quantities said to exist in the South Wales basin by Mr. Bedlington, or in the Monmouthshire district by Mr. Bassett. It required far more deliberate and searching investigation before any man could accept the enormous quantities said to be unworked; at all events, he (Mr. Brough) could not believe in them.

Mr. Bassett said that Mr. Brough was hardly warranted in the remarks which he had just made. He (Mr. Bassett) was not going to put himself forward as infallible, but if Mr. Brough would only read his (Mr. Bassett's) paper which he did not believe he had, he would have seen exactly how he had arrived at the conclusions he had. The quantities of unworked coal in the Monmouthshire district were not based upon his (Mr. Bassett's) own authority solely, nor were they unsupported by evidence of high repute. When the proposed Alexandra Docks for Newport were before the Parliamentary Committee he was engaged with Mr. Abernethy, the engineer for the promoters, and it became necessary to place before the Parliamentary Committee the total extent of the coal field which those docks proposed to serve; and in order to ascertain the exact quantity of coal it was necessary to get the best assistance and statistics possible. The promoters of the docks, therefore, obtained the assistance of Mr. Adams, who was well acquainted with the whole of the Ebbw Vale district, Mr. William Llewellyn, the agent of Lord Llanover, and Mr. T. Forest Brown, and these gentlemen went very carefully over the whole matter. They got sections of the whole county, divided those sections into different parcels, if he might be allowed the expression, and it was not before day after day, and week after week, of most careful consideration that they had arrived at the conclusions which they had. He had stated

in his paper that he had gone through the whole district, and had first ascertained the total number of acres of coal, assuming them intact, then calculating the quantity of coal worked up to the present time, and then to take the average depth of the thickness of the coal, after which to ascertain the consumption of coal per annum, and up to the commencement of the present century they had ascertained the total quantity of unworked coal to be 2,115,000,000 of tons. After arriving at these results (and it would take a long time to explain how they did so in different districts, but after a great deal of trouble and care, and not with a hurried computation) they estimated the quantity of coal raised up to the present time, or the end of 1864, which they found to be about 115,000,000, so that there were at the present time about 2,000,000,000 of tons now unworked. He (Mr. Bassett) would remark that he could not possibly have given so much time and attention to this subject, but that he had been employed by the promoters of the Alexandra Docks, to whom it was most important that correct figures should be obtained.

Mr. BEDLINGTON said that as Mr. Bassett had made a few remarks in vindication of his paper, he (Mr. Bedlington) ought, perhaps, to do the same. Something more than the mere statement, "I dont believe," was required before the calculations which he and Mr. Bassett had made could be said to be incorrect. Having introduced the matter, he hoped that some reasons would be given why their calculations were disputed beyond the simple assertion "I don't believe." The plan which he pursued in making his calculations was the same that was pursued by every mining engineer when he was going to win coal. They had first ascertained the area of the coal field. If the area was wrong they would be very glad to be set right, because they had introduced the subject in order to provoke discussion. Having ascertained the area, they then proceeded to ascertain the average thickness of the coal, and these two things being found they had given the result. They had ascertained the details of the sections in different parts, and they had then taken the average thickness of the coal; but, of course, all they could do was to give a general approximation of that which at present existed unworked. They had adopted the proper mode of calculation, and they now merited discussion to ascertain whether they had made any mistakes or whether the contrary was the fact. Were the areas of the coal right or wrong—was the thickness of the various seams right or wrong? Having ascertained those two points, he should be glad to know what was the probable quantity of coal still remaining unexhausted. He (Mr. Bedlington) had adopted a different mode of calculation to that of Mr. Bassett, but he had arrived at very nearly the same results, He had calculated that there were about 56,000 acres of coal at present unworked, which would produce about 53,776,000,000 tons, whilst——

Mr. BASSETT said that perhaps Mr. Bedlington would pardon his interruption, but he wished to state that there was a slight error in his (Mr. Bassett's) paper, he having included a small portion of the Caerphilly district in that of Monmouthshire, which, of course, he should not have done. That district embraced an area of about 2700 acres, so that if that were substracted from his total computation would give his figures at 54,432,000,000 tons.——Mr. BEDLINGTON said that being the case, made their calculations more in accordance with each other, and there was certainly a very great closeness in their results.

The PRESIDENT said he had taken some little trouble in reference to the various sections of coal, more especially in the Dowlais division, and so far as he was able to ascertain he quite agreed in the results arrived at by both Mr. Bedlington and Mr. Bassett as to the quantity of unworked coal; at all events, so far as regarded that contained in seams of 2 ft. and upwards.

Mr. T. DYNE STEEL said, if he rightly understood the remarks of Mr. Brough, he did not so much dispute the method of calculation adopted by either of the writers of the papers so much as that the quantities of coal did not exist—that was to say, the quantity of soft coal was more than stated.

The PRESIDENT said that 12 per cent. had been allowed for that.

Mr. ADAMS said it was very much more than that—about 35 per cent.——Mr. BASSETT said he was sure that he and Mr. Bedlington had rather under rated than over estimated the quantity of coal. He was quite satisfied that they were correct in their mode of calculations.——Mr. BEDLINGTON asked whether it was thought that they could get at workable coals to the depth of about 800 yards in the South Wales district?—The PRESIDENT said he did not think they would.

Mr. BASSETT said he did not think they would be able to do so in the Monmouthshire district. He did not know as to the Neath district.

Mr. BEDLINGTON said that the stratification in Monmouthshire was less than that in Glamorganshire. The seams of coal were, generally speaking, thin towards the east and thicker towards the west, and there was a greater thickness throughout Glamorganshire than Monmouthshire. He might have given page after page of sections to prove the correctness of the calculations which he had made, but he thought it better not do so. In some districts the coal was much thicker than in others; if he had thought that the average thickness would have been attacked he would have prodnced the sections to prove the correctness of his calculations. When they were told that the coal would be exhausted in a short time, he thought that the mining engineers of the South Wales district should go over their portion of the coal basin in order to ascertain whether the statement was correct. There were a great many gentlemen present well experienced in the district, and he (Mr. Bedlington) should be glad to hear from them whether they considered the calculations made were or were not correct.

Mr. MENELAUS said it should not go forth to the public that Mr. Brough, occupying the position he did, meant to say that he did not believe that the figures of the two engineers who had written the papers were correct. Both gentlemen had endeavoured to ascertain as near as they could the quantity of coal unworked, and both had taken very great pains to arrive as nearly as possible at the results. The opinion of all practical men was that there need be no anxiety that the coal would be exhausted, at all events in the South Wales district, for a very long time yet to come. He regarded the remarks of Mr. Brough, therefore, as nearly half joking. If Mr. Brough meant seriously to deny the figures which had been given, he would have been sure to have shown by other figures where they were wrong. There was a gentleman present at the meeting—Mr. Adams—who was engaged at the present moment in preparing facts and figures to determine this question on behalf of the Government. He should, therefore, be glad to hear from Mr. Adams whether, giving an off-handed opinion, he though that Mr. Bassett and Mr. Bedlington had overstated the quantity of coal in this district.

Mr. ADAMS said, on the contrary, he believed both were within the bounds very much. He should not like to say very much at that meeting as to the depths they would probably have to go far for coals, but they would have to go somewhat deeper in Monmouthshire than in Glamorganshire, but not much. Certain facts had come to his knowledge within the last fortnight which went to prove that the coals in Glamorganshire generally were not so deep as some people thought. For his own part, he was quite prepared to believe in the facts and figures produced by both Mr. Bassett and Mr. Bedlington.

Mr. MENELAUS said that this subject—the probable quantity of unworked coal—was producing a great deal of interest in the public mind, and it would be a misfortune if it went out to the world that any doubt had been thrown upon the results arrived at by the gentlemen who had written papers thereon. If anyone doubted the figures given, he ought to be prepared with other figures to counteract those given by Mr. Bassett and Mr. Bedlington. Mr. Adams had taken more pains in this matter, if possible, than either Mr. Bassett or Mr. Bedlington, and that because Mr. Adams had treated it as a matter of business, and he had stated that he believed those gentlemen were under the mark. Having only one dissentient, they, as an association, might take it for granted that the figures stated were as nearly correct as it was possible to ascertain.

Mr. T. DYNE STEEL said that he had been opposed to Mr. Bassett on behalf of the Dock Company before the Parliamentary Committee, and he believed the figures produced were correct. They had not in the slightest degree attempted to deny, or even to test, the accuracy of the figures he had produced, because they firmly believed they were correct.

Mr. BASSETT said he considered that what Mr. Steel had just said was the greatest compliment which could be paid him, inasmuch as they had been opposed to each other in the matter of the Alexandra Dock Company. The old Dock Company had endeavoured to move heaven and earth in their opposition, for after producing a host of engineers they had brought forward Mr. Dobson, who was acknowledged to be a very great authority upon such matters, but all that Mr. Dobson had stated was that he believed they, on behalf of the promoters of the Alexandra Dock Company, had over rated the quantities of coal, but he had not ventured to give any figures in proof of such an assertion. Mr. Steel had also been asked by the counsel almost every other question except that in reference to the quantities of coal to be found in South Wales coal basin, and the reason of that was that he had gone into the question, and had found the estimates made on behalf of the Alexandra Dock were correct.

The discussion was then brought to a close.

ON THE CORNISH ENGINE.

BY MR. M. LOAM.

The discussion upon this paper has been frequently postponed.

In reply to a member of the Institute, Mr. ROE, of Cardiff, said that there was nothing to prevent the principle of the Cornish engine being applied to every work to which other engines were applied. The Cornish engine—*i.e.*, the single-acting expansive condensing engine—described in the paper, may fairly claim a large amount of credit on the score of economy in the use of fuel, due to a high grade of expansion, the prevention of loss of heat from radiation, by clothing exposed surfaces with non-conducting matter, and a judicious proportion observed between the grate surface and the heating surface of the boiler. And more, to the Cornish engine they were indebted for the double heat valve, the lantern brass, and the cylindrical boiler, with its internal cylindrical flue tube, together with the continued use of the steam-jacket, after it had been discontinued by most engineers of the present day. In estimating the work done by the Cornish engine, the number of millions of pounds raised 1 ft. high by the consumption of 112 lbs. of coal is the standard usually employed. Now, this imposing array of millions of pounds had rather a bewildering effect on the mind, and tended to misconception on the part of a great many persons as to the work really done by the Cornish engine. Thus, 80 millions of pounds raised 1 ft. high by 112 lbs. of coal, reduced to our ordinary standard of comparison, was equal to 2¾ lbs. of coal per horse power per hour—60 millions, 3¾ lbs., and so on—a result constantly realised, even in the marine engine, with its comparatively low boiler pressure, the use of salt water, and rapid combustion per foot of grate surface—often three times as much as consumed in the Cornish engine on land——Mr. MAYNARD said that if he understood the purport of the paper, and the observations made by Mr. Row, they were to the effect that single-action engines were considered more economical, and recommended their adoption generally. The notion of compound engines seemed to be altogether discarded. He (Mr. Maynard) had, however, seen some most successful results from small compound engines, and he believed that even more successful results had been obtained than he had seen.——Mr. LOAM said that one feature in the Cornish engine was the expansion of steam, and this, of course, required space. All the experiments which he had seen tried went to show the superiority of the single-acting engine.——Mr. MAYNARD asked whether the Cornish engine could be applied to marine purposes?——Mr. LOAM said that the principle of steam expansion, which they claimed for the Cornish engine, was capable of being applied to any engine whatever, whether a marine engine or any other.——This closed the discussion.

ON PUMPING AND WINDING.

BY MR. COPE PEARCE.

The PRESIDENT said the next paper for discussion was that upon 'Pumping and Winding," by Mr. Cope Pearce. In this paper, after a few prefatory remarks descriptive of the pumping-engines employed in the North (which the writer says are not worth copying for the South Wales district), he proceeds to describe the winding-engine, as follows:—The favourite winding-engine in the Newcastle district is a vertical engine, with two beams arranged to form a parallel motion; one of which is sometimes used to work a pump, and the drums are overhead. The pit-head framing is placed near the engine-house, and there is a platform with railings connecting them together. This is a convenient arrangement, as the engineer can oil the crank-shaft and then go over the platform to examine and oil the sheeves without much loss of time. The working valves used are double-beats, and are worked by means of the old-fashioned plug-rod with two handles, and the old-fashioned catch. The Newcastle engine drivers say this is the best gearing that can be used, and their system of handling is this:—The length of the ropes are adjusted so that the crank is about 30° from the top centre, and turned towards the pit, when the carriage attached to the upper rope stands on the fans about 30° from the top centre, and turned away from the pit when the carriage of the lower rope is standing on the fans. By the upper and lower rope the writer means the rope which passes over the drum, and the rope which passes under, or is wound by the lower part of the drum. The advantage of this arrangement is that the engineer has to move the handles in the same manner for both carriages, no matter which is on the fans, as the carriage will always be raised off the fans if he presses down the right handle, and lets the left handle fall down a little, and the carriage will always start down the pit if he raises the left handle and lets go the right.

When the engineer raises the carriages off the fans there is no great danger of over-winding with the ropes adjusted as described, because the engine can only move 30° to the top centre, which is not motion enough to take the carriage up to the sheave. In checking the speed of the engine the engineer does not often use a throttle-valve, but merely retains the handles, so as to limit the opening of the valves. This gearing has, of course, the defect of always applying the steam to move the engine in the direction in which it is already going, or, in other words, it cannot be made to act against the engine except by continually hand-gearing, and there is no provision to throw the plug-rod out of gear in these engines, and so far they are not so complete as the old Staffordshire engines. The engineer in stopping sometimes shuts the valves with steam in the cylinder, and, to prevent the engine getting strained from this cause, it is usual to make the diameter of the upper beats of the steam-valves much larger than the diameter of the lower beats, and to work these valves by loops inside the valve-boxes, which allows the confined steam to lift the steam-valves, and pass back again into the boilers. This is not as good a plan as the safety-valves fixed on the ends of the cylinder, because it makes the valves heavier to lift, and if the valve should chance to stick open from dirt or any other cause there is no way to shut it again without opening the valve-box. The Newcastle engines, with plug-rods, are worked at a slow rate, and the speed of the rope is got up by using very large drums, and the engine is larger in proportion. In the writer's opinion a smaller engine, going faster, with drums of moderate dimensions, is far more manageable, because the rope can then be moved slowly when required; but with large drums it is more difficult to move the carriage quietly, as it will run a considerable distance if the engine is moved only a little. * * * * Where a single engine is used, the writer prefers putting it horizontal, because the engineer has a better sight of the crank, which is, he thinks, a matter of consequence. When the carriages land on the fans, the handling can be done as he has described by looking at the ropes; but if repairs are going on, or the carriage is required to stop in various parts of the pit, it then becomes necessary to fairly handle the engine, and the crank to do this ought to be in sight. For a single engine, winding on the first motion, the writer prefers the plain handle to the slot-link, which has not so much command over the engine when near the dead centres, and for this sort of work he likes lifting-valves better than slides, because you can feel when they are shut, but you cannot feel when a slide-valve stands half way. For winding on the second motion, with a small engine going very fast, a slide-valve with a slot-link motion answers very well, and is, no doubt, best. It is easy to handle, and in this case it does not matter within a trifle where the engine stops.

In Wales, double winding-engines with slot-links are coming into use, and they certainly have some advantages over the single engine. For sinking, or doing repairs in a pit, they are decidedly the best. A less skilful engineer can work them. They feel pleasanter to go down a pit with, and are more manageable if the ropes are not balanced, but for only winding coal and landing it some engineers still prefer the single, engine for the following reasons:—It is cheaper. The engineer is not obliged to notice which carriage is up, but with a slot-link he must. In raising the carriages off the fans, supposing the length of the rope adjusted as before described, if the engineer should neglect to reverse the handle in time enough, there will not be so much danger of over-winding as with a double engine, because the single engine has only 30° to run to the dead centre, but a double engine with slot-links under the same circumstances might overrun a considerable distance. The writer must, however, mention that the advocates for the single engine assume the ropes to be balanced by a balance chain or spiral drums; and if this is not the case, the engineer must be very careful in raising the carriage; for if it goes a little too far, the weight of the rope hanging down the pit will take the crank over the top centre in spite of him, and in a case of this kind, with ropes out of balance, a double engine is safer, being always ready to hold back. A double engine does not require a fly-wheel, consequently there is less momentum to overcome when the engine is stopped or started. The writer has said nothing about brakes in connection with handling engines, because they can be done without, as far a simple winding is concerned; but they are handy for lowering materials down a pit, and when castings or other heavy weights cannot be landed, but have to hang by the rope and remain stationary, it is difficult to keep the engine quiet, and if the steam is shut off the weight will overcome the resistance and friction of the engine and descend. Shutting all the working valves will not always hold against a heavy load, especially if they are a little leaky. In this case a brake is of use if powerful enough. Brakes moved by screws are too slow, levers, again, are not powerful enough, and, no doubt, a steam-brake is the best, but it must have diameter enough to do the work without the help of a lever, and ought to act direct upon the strap, with only just stroke enough to pull it up tight, or else it gives a very unpleasant blow when put in action. The writer thinks the engineers of the Newcastle district would like steam-brakes if they gave them a trial, but many of their winding-engines are low pressure, and, of course, the brakes would require large-cylinders.

Ogden suggests shutting up the discharge pipes of an engine to stop it, by means of a self-acting "Finger," in the pit head framing, in case of the engineer becoming disabled, and the writer thinks the suggestion worthy of attention; at all events, it is advisable to put the valve-handle in such away that it will not stay in gear without the engineer holds it. The writer has told you a little as to winding from what he has experienced in handling engines himself, and from watching and talking to engine-drivers in different districts, but he has not given any decided opinion as to which form of winding engine is best, because it seems to him quite as nonsensical for an engineer to adopt one form of engine to suit every case, as for a doctor to prescribe one sort of medicine for every disease. The engineers in Wales have been obliged to make engines of various forms from time to time to suit circumstances, and the nature of the locality, but luckily they have never got into a groove so as to fancy their doings perfect, and so far there are hopes of our progressing. If we take the engineering of the North as a standard by which to measure our own progress, we find that we do actually move forward, and with very rapid strides. The writer does not think engineers in Wales can do better than go on as they have heretofore done, and that is to glean what will suit them from all the other mining districts, and contrive a little for themselves also.

Mr. BROUGH said that in the North of England the double cylinder horizontal engine was the general favourite, and not the engine described in the paper. The one which had been described had been tried, but the double-action horizontal engine was fast coming into general use.——Mr. MENELAUS preferred the vertical engines over the double-action engines.——Mr. BROUGH said that the double-action horizontal engines consumed a great deal of coal, but the great object to be attained was security of action, and it was upon this account that the double-action horizontal engine was getting into general use.

Mr. RICHARDS said it would not do to put up a high-pressure engine, which wasted so much coal, where coal was valuable. He believed a vertical engine with a drum overhead to be far more economical. It would not do for colliery managers to tie themselves to the engine alluded to by Mr. Brough, because of the heaps of coal in some pits which should be got rid of. Where they could not obtain much coal for the use of the engine, or where coal was very valuable, they ought to put up condensing engines, and let them work as economically as possible. That was not to be obtained by the horizontal high-pressure engines.

Mr. BROUGH said the engine at Abercarne, to which Mr. Richards alluded, had all the essential principles of the double-cylinder vertical condensing engine, and it was certainly one of the fastest in the world. He had heard of an instance (at Ebbw Vale) in which an high-pressure engine, consuming 100 tons of coal per week, had, by its being converted into a condensing engine, reduced its consumption of coal to only 30 tons per week.

After a few remarks from one or two members as to the economy of the condensing engines, the discussion was brought to a close.

THE COAL "BRASSES" OF THE SOUTH WALES COAL FIELD.

BY MR. ADAMS.

The PRESIDENT said the next subject was Mr. Adams's paper "On the Coal 'Brasses' of the South Wales Coal Field," of which the following is a copy:—

Nearly twenty-eight and a half centuries ago it was written "There is no new thing under the sun;" this may well be said of the subject the writer purposes bringing under the notice of the members of the Institute. At the meeting of the British Association, held at Glasgow, in September, 1855, a paper was contributed by Messrs. E. C. Nicholson and David S. Price, Ph.D., F.C.S., both chemists of considerable reputation, drawing attention to the value of this mineral; again in the "Mineral Statistics of Great Britain," for the year 1857. Mr. Hunt, F.R.S., republished the paper read at Glasgow; and in 1864 Pr. Percy also alludes to this mineral in his valuable work on Metallurgy, in the volume "Iron and Steel," page 203. Yet the writer has found in the course of his visits to various collieries in this coal field, during the past year or two, that neither paper had come under the notice of the coal proprietors and managers; and the Statistics for 1857 being out of print, he has deemed it his duty to the Institute to re-write the Glasgow paper, adding to it Mr. Hunt's and Dr. Percy's remarks, with a few that have come more immediately under his own notice, and thus prevent the continuing the waste of a most valuable ironstone, more especially while such a scarcity of ironstone exists at the different ironworks of South Wales and Monmouthshire. This is not like the ironstones of the coal field generally, which are worked separately, and becomes a question of cost of getting, and if not "gobbed," still remains in the ground untouched, to be worked at some future period, and no loss is sustained by either landlord or tenant. But the working of the "coal brasses" prevails with the working of the coal seams, and is now, almost without exception, either "gobbed" in the colliery or sent into the "rubbish tip," being thus entirely lost to future generations, and a present loss to both colliery owner and landlord. The Glasgow paper is as follows:—"On the Chemical Composition of some Iron Ores, called 'Brass,' occurring in the Coal Measures of South Wales," by E. C. Nicholson and David S. Price, Ph.D., F.C.S. The ores to which this paper referred are held in low estimation, and even rejected by some ironmasters. It was with a view of explaining the reason of this that their examination was undertaken. There are three varieties of this ore:—1. One is compact, heavy, and black, from the admixture of coaly matter; when broken it exhibits a coarse pisiform fracture.—2. Another is compact and crystalline, not unlike the dark-coloured mountain limestone of South Wales in appearance.—3. The third variety is similar in structure to the first-named. The granule, consisting of iron pyrites, are mixed with coal, and apparently cemented together by a mineral substance of like composition to the two foregoing. It is from the yellow colour of this last variety that the same name "brass" has been given to the ores by the miners. The following is their composition:—

	1.	2.	3.
Carbonate of iron	68·71 = iron, 33·3	59·73 = iron, 28·83	3.
,, manganese	0·42	0·37	17·74
,, lime	2·36	11·80	—
,, magnesia	11·80	15·55	14·19
Iron pyrites	0·22	trace	13·96
Phosphoric acid	0·17	0·23	49·72
Coaly matter	8·87	9·80	trace
Clay	—	2·70	6·10
Total	99·55	100·18	99·81

The Ores 1 and 2, to which attention is directed as being those to which the remarks apply, may be classified with the spathose carbonate of iron. The absence of clay, and the difficulty, from ignorance of this fact, that would in consequence be experienced in smelting these ores, sufficiently explain the reason of the disrepute in which they have hitherto been held; for, when judiciously treated in the blast-furnace, they smelt with the greatest facility, and afford an iron equal to that produced from the argillacious ores. It will be evident, from the large amount of lime and magnesia which they contain, that their employment must be advantageous in an economical point of view. An interesting feature in these ores is their fusibility during calcination on a large scale. When this process is conducted in heaps, the centre portions are invariably melted. This, considering the almost entire absence of silica, is apparently an anomaly. The fused mass is entirely magnetic and crystalline. Treated with acids it dissolves with great evolution of heat. Its composition is:—

Protoxide of iron	33·26
Sesquioxide of iron	32·50
Protoxide of manganese	0·38
Lime	12·84
Magnesia	13·87
Phosphoric acid	0·17
Sulphur	0·23
Silicic acid	1·20
Alumina	0·51

From the above analysis it is possible that its fusibility is owing to the magnetic oxide of iron acting the part of an acid. When thoroughly calcined and infused, the ores retain their original form, and if exposed to the air for any length of time crumble to powder, from the absorption of water by the alkaline earths. Mr. Hunt's reprint in his "Mineral Statistics" for 1857, page 52, has the following addition only:—"It is necessary to allude to the third variety; as an iron-making material, its colour admits of its being at all times separated from the others. The pyrites which it contains, we may remark, is bi-sulphuret of iron." Dr. Percy, in his book on "Iron and Steel," at page 202, says:—"Those who are enaged in raising coal and the associated ironstones would do well never to throw anything away of the nature of which they have no reason to be absolutely certain. During the last few years I have known several instances in which ironstones, previously rejected as worthless, have been found on examination to contain a large amount of iron, and, consequently to possess considerable value. As a striking example of this may be adduced the ironstone occurring in association with coal in the district of Merthyr Tydvil, and known as 'Duffryn Brass.' It is only a few years ago that its nature was ascertained. It is heavy, stone-like, and brownish-grey in colour, and has sold as high as 14s. per ton." The writer is indebted to Mr. E. Riley for the following analysis of a specimen of it:—

Carbonate of protoxide of iron	58·48
,, manganese	0·71
,, lime	10·68
,, magnesia	21·90
Phosphate of lime	0·09
Bisulphide of iron	0·09
Coal	8·95

The price mentioned by Dr. Percy could not have been obtained for the ordinary "coal brass," but for the true iron pyrites, such as found in the "brass veins of coal" and in the fine clays, and found also to a small extent in the hematite mines of Llantrissant, where it is called "mundic," and sold to the makers of sulphuric acid, at a price of about 15s. per ton, in wagons at the mines. At the Nant-y-Glo and Ebbw Vale Works, in Monmouthshire, the "coal brass" for many years has been utilised; In the former works, in the blast-furnaces alone; but in Ebbw Vale it was used for "fettling" purposes in the puddling furnaces, after calcination, and the small and not properly burnt portions were sent to the blast-furnaces. In 1857 the following examination of "coal brasses" was made by Mr. George Parry, the chemist, at the Ebbw Vale Ironworks:—

Raw state:—	Metallic iron.	Sulphur.	Phosphoric acid.
A dark-coloured sample from middle of a heap, which had been exposed to the atmosphere for several years	41·00	0·183	—
From surface of same heap—a red colour	43·00	0·186	—
Calcined state:—			
Slightly calcined—red colour	45·30	—	—
Burnt hard, but not fused	58·50	—	—
Burnt very hard, but not fused	60·40	—	—
1.—From middle of clamp, fused	59·00	—	—
2.—Burnt moderately hard	59·60	0·110	9·220
3.—Raw	—	—	—
A poor sample, containing much coaly matter, and fresh from the colliery	33·50	—	—
Another sample	36·00	—	—

It is remarkable that, without exception, the whole of the buttons of iron obtained by these assays were strong, dark-grey iron. The iron obtained from Nos. 1, 2, and 3 was analysed, and the sulphur contained in each as follows:—No. 1, 0·147; No. 2, 0·124; No. 3, 0·227. When calcined as No. 2 it was worked in the blast-furnace, and made a good forge pig-iron, from the following burden:—Calcined Welsh mine, 7 cwts.; calcined "coal brass," 2 cwts.; red ore, 4 cwts.; calcined mill and forge cinder, 3 cwts. For some time there was a difficulty in persuading the blast-furnace fillers that the "coal brass" was as rich in iron as the Cumberland, Lancashire, and Ebbw ores, and their overburdening the furnace caused a rough, coarse pig-iron, which they attributed to sulphur—a mineral very often blamed without cause. The loss during calcination is very considerable, amounting to from 40 to 50 per cent.

Mr. ADAMS referred to a meeting held in the North of England in 1863, respecting the "coal brasses," and handed in the paper, which he wished to be printed with the Society's Proceedings, together with an analysis.

The paper on "The Tillery Coal Seams and Workings, at Abertillery," by Mr. Dyne Steel, was illustrated by several diagrams hung upon the walls, but the paper did not lead to any discussion. A vote of thanks was, however, awarded to the writer.

In consequence of the late hour, the reading of the following papers was compelled to be adjourned:—"On Davies' Self-Acting Steam Striker," by Mr. D. Davies; "On Patent Fuel," by Mr. Bassett—[Mr. BASSETT stated that experiments were now being made by Government officials in reference to this matter, and he should have great pleasure in adding the result of those experiments to his paper if adjourned till next meeting.]—"On Bessemer Steel," by Mr. W. Child; and "On Over-winding, and How to Prevent It," by Mr. W. Fairley.

A vote of thanks to the President closed the proceedings.

THE DINNER was held at the Cameron Arms Hotel, High-street. About 70 of the members and friends sat down to an admirable spread, provided by Host Dodd, which gave general satisfaction. The CHAIRMAN gave the usual loyal toasts—the "Army, Navy, and Volunteers" being responded to by Captain JAMES and Lieut. RICHARDS.

Mr. BROUGH said he had been requested by the respected President to propose what he supposed was the toast of the evening, namely—"The Coal and Iron Trades of the Great Principality," coupled with the name of the town in which they were assembled. Swansea had already risen out of the sea, and become one of the seats of the coal and iron trades of South Wales. He did not see the Mayor of the town there; his worship had not honoured them with his presence. However, he would give them the great, rich, and improving country, and Mr. Menelaus' long acquaintance with the great sources of its prosperity would enable him to speak on the subject better than he could. He had been acquainted with Swansea for about ten years, and had never failed to see the chief magistrate present at their meetings. But the chief magistrate was not there. Mr. Moxham and the local committee could, doubtless, tell them why he was not. He had pleasure in proposing the toast, coupled with the name of Mr. Menelaus.

The toast was drunk with Swansea honours.

Mr. MENELAUS, in responding, said he had always great pleasure in being at the society's meetings. He thanked them for coupling his name with the toast, although the trade of the Principality was in such a depressed state at present that the least said about it the better. (Laughter.) He hoped that before they were a year older it would be in a state of prosperity again.

Mr. BASSETT next proposed "The Town and Trade of Swansea:" Although he belonged to the other end of the country, and was interested in Newport and Cardiff, he was glad when he came there to find Swansea doing a thriving trade. He, too, was sorry the Mayor was not there to respond to the toast. He saw a gentleman present, Mr. Glasbrook, who was the lessee for the Duke of Beaufort, and he wished all lessees were like Mr. Glasbrook. (Hear hear.) He coupled the toast with Mr. Glasbrook's name.——The toast having been drunk,

Mr. GLASBROOK responded. He was sorry their most respected Mayor was not present. He hoped the trade would soon return again. He should be glad to see them not once but twice a-year. He thought the absence of the Mayor from that meeting was a sort of "snubbing" to the engineers of South Wales. ("No, no," and laughter.) The Mayor ought to have been there. It it were not for the scientific gentlemen he saw around him Swansea would have to shut up the port altogether. He begged to return thanks for the toast of "The Town and Trade of Swansea," although he was only a small trader himself.

Mr. BROUGH said that, in the absence of Mr. Wales, he had to propose the health of a gentleman, than whom there was no one more esteemed in this Welsh world of theirs, and one whom he was sure would be esteemed in the other world if he were only known there. (Laughter). He gave them the health of their President—Mr. Martin. He had seen many others fill the office, but by none better than him, in the mode in which he conducted the transactions of the Institute. Whilst in office he had not lost a friend but made several. He was so estimable, so good, that he felt great satisfaction in giving them "Long life and Prosperity to their worthy President."

The toast was drunk with much cordiality, and Mr. MARTIN returned thanks.

Mr. BASSETT then proposed "The Health of Mr. Brough," who had kept them all in such a happy mood. He sometimes came into collision with him, but whenever he differed, he did it in a gentlemanly manner.

The toast was drunk, and Mr. BROUGH returned thanks. He said Mr. Wales, his colleague, and himself had done their duty, was doing their duty, and intended to do their duty. At the same time they endeavoured to do it as gentlemanly as they could.——Mr. WADDLE then proposed "The Health of the Con-

tributors of Papers," which was responded to by Messrs. STEEL, ROE, and COPE PEARCE.—Mr. COPE PEARCE then gave a song, and after one or two more toasts had been drank, the company broke up.

THE PARIS EXHIBITION—No. XVII.

[FROM OUR OWN CORRESPONDENT.]

The number of FRENCH METALLURGICAL ESTABLISHMENTS represented at the Paris Exhibition is very considerable, and among the most remarkable may be mentioned the works of Creusot, Châtillon and Commentry, Montataire, Audincourt, the steel works of Petin and Gaudet, Terre-Noire, Jackson, Sireuil, and the St. Louis furnaces. The CREUSOT WORKS, the largest in France, and which gives employment to 10,000 workmen, producing no less than 110,000 tons of iron annually, has made a magnificent show. The intellectual resources of the establishment are as well represented as the practical, and it would be an interesting study to make a comparison of the character of labour bestowed, and of the results obtained. The Creusot Works exhibit their irons in seven classes, which consist of No. 1, tendre, for rails; No. 2, ordinary, closely resembling that of Staffordshire; then follow Nos. 3, 4, and 5 respectively; No. 6, which is analogous to the Yorkshire iron; and No. 7, qualité extra, considered to be equal to charcoal iron or to that of Lowmoor. The price of the No. 2 (by which all other numbers are regulated) is 7*l.* 12s. per ton, free on the railway-trucks at the works, the advance for other numbers being—No. 3, 2 fr. 50 c.; No. 4, 5 fr.; No. 5, 9 fr.; No. 6, 14 fr.; and No. 7, 20 frs. the 100 kilos. (1-10th ton). In the Creusot shed the fine locomotive manufactured for the Great Eastern Railway (England) should be especially examined, as affording a proof that for high class workmanship neither frontiers nor distance is an obstacle. Creusot exhibits no *tours de force*, but within fifty paces of the Creusot exhibition can be seen the beautiful triple crank-shaft, weighing 30 tons, shown by the BROTHERS MARREL, of Rive de Gier; it is the largest forging in the Exhibition—it was made under a hammer of 20 tons, but capable of being loaded to 30 tons. Near this monster is another shaft, with four cranks, which is alike remarkable for its beautiful proportions and excellent finish. The COMMENTRY AND CHATILLON Works employ about 9000 men at their various establishments, which are situated in five provinces, and annually send into the market about 70,000 tons of metallurgical products; their collection includes wire, black plates, tin-plates, sheets, sheets covered with lead, galvanised sheets, armour-plates, iron and steel rails, and merchant bars of almost every description. In most of these kinds there are extraordinary specimens, which show that excellent tools and labour must have been employed. The MONTATAIRE and AUDINCOURT also exhibit, but upon a much smaller scale, various products worthy of special mention, particularly in sheets and tin-plates. At Montataire they chiefly employ, after carefully sorting it, the scrap-iron collected at Paris, and the tin-plates of Audincourt are manufactured, with a new apparatus for tinning at the rolls invented by Mr. GIRARD, and which may also be seen at work at the Exhibition. Audincourt delivers its manufactures free at the railway station nearest the purchaser, when the cost of carriage does not exceed 20 frs. per ton. The whole of the establishments already mentioned exhibit specimens of iron only, but France has also made immense progress in the manufacture of steel, and this is especially apparent in the present Exhibition. Messrs. PETIN, GAUDET, and Co. hold the highest place for the magnificent results they have obtained in the manufacture of steel, which may be regarded as embodying the great future of the iron trade. Like that of Creusot, their display is complete; they show fuel, ore, pigs, iron, and steel. The society, which owns six other works in different departments, employs 5200 men, steam power equal to 6000-horse power, and produces annually about 50,000 tons of iron or steel, representing a total value of 30,000,000 to 35,000,000 of francs. The manufacture of steel is carried on entirely in the Assailly (Loire) Works, where they have a steel foundery, employing 500 crucibles, and capable of melting 15 tons at a time; two 7-ton and one 9-ton Bessemer converters, and 15 cementation furnaces. Amongst the most remarkable articles which they exhibit is an ingot of cast-steel, which is a metre square, and weighs 25 tons; the ingot has been broken in the middle to show the homogeneity of its texture, and its absence of air-bubbles. At the present time Messrs. PETIN and GAUDET are in a position to run, and work ingots of from 30 to 40 tons without difficulty. One of the most happy applications of steel is its employment in the manufacture of guns. At the gun factory at St. Etienne they severely tested three sporting guns, and it was found that calibre No. 12 only gave way with the, for a sporting gun, enormous charge of 104 grammes of powder and 300 grammes of shot. No. 16 took 60 grammes of powder and 150 grammes of shot; and No. 20 took 45 grammes of powder and 84 grammes of shot to burst them. Messrs. PETIN, GAUDET, and Co. possess the best elements of success in an excellent and abundant supply of mineral. The firm works the mine of Saint Leon, in the island of Sardinia, on a large scale; the ore is very pure, giving a fine steely iron, and of 62 per cent. produce. The mine was discovered in 1862, and at present yields about 50,000 tons per year, but this will soon be quadrupled.

The blast-furnaces of Saint Louis, near Marseilles, employs large quantities of ore from Spain, of 60 per cent. produce. With these ores they produce Bessemer pig, which has been most successfully employed in many of the French works, entirely driving out the British pigs, which were formerly used in them. In spite of the high price of fuel, caused by the distance whence it is obtained, the price at which these pigs are sold is but 4*l.* 4s. per ton. The spiegeleisen is sold at a much higher price: it is quoted at the St. Louis Works, 6*l.* when it contains 7 per cent. of manganese, and 4s. per ton more for each 1 per cent. of manganese in excess—specimens are exhibited containing 9 per cent. of manganese. TERRE-NOIRE and IMPHY-SAINT-SEURIN also show some remarkable products in Bessemer steel, the fracture of the ingots broken, crude and hammered, showing great perfection of workmanship. Merchant bars of Bessemer steel are quoted 16s. per ton above similar bars of ordinary iron, the purchaser pays the 2*l.* per ton inventor's royalty. The bridge under which we pass from the park to the boats and other things by the water side, near the Pont d'Jena, is made of the Terre-Noire Bessemer steel, and is remarkable for its strength, elegance, and lightness. The cast-steels of DORIAN HOLTZER, of Pont-Salomon, should also be favourably mentioned. The Firminy (Loire) Works exhibit specimens formed of iron allied with steel, such as bars with iron in the centre and steel on the outside—the iron to give tenacity and the steel hardness. The products appear to be of good quality, but experience has shown that in the long-run inconvenience too often results from the steel separating from the iron.

The Works of SIREUIL (Charente) exhibit a new steel of very fine quality, obtained by a new process—that of Mr. PIERRE MARTIN—which, in the opinion of competent judges, has many chances of success. By this process the steel is made upon the sole of a reverberatory furnace, heated by gas to a very high temperature by the use of SIEMENS'S regenerative furnaces, the value of which have been recognised at Paris by the award of a gold medal to him. Pig-iron of great purity is treated and refined by contact with oxidising matters equally pure. The decarbonisation, thanks to the excessive temperature and the absence of *brassage*, takes place slowly, and thus the foreign matters are driven out of the iron. They make either a steel, or a homogeneous metal in large masses of determinate quality, by judging from test pieces, which can be taken at any minute. They say that at Creusot, where up to this time no steel has been manufactured, they are about to introduce the PIERRE MARTIN process, which would be a sufficient evidence that the invention is worthy of serious attention. Another process is also being experimented with—that of Mr. BERARD, who is already known in connection with several successful inventions—at the Montataire Works, where they are endeavouring to make steel upon a double-soled reverberatory furnace, by submitting the bath of pig-iron to oxidising and reducing influences alternately, in order to prolong the operation and permit of the complete purification of the iron; this is effected by reversing the flame, and making it pass over a wall of fuel, which gives it a carburating property. The metallurgical products of France are thus nearly disposed of, so far as iron and steel is concerned, and the notice of the similar exhibits of Prussia, Austria, Sweden, England, and Belgium must be deferred until some future opportunity, although they are not less interesting than those of France.

We have seen that in the French section steel occupies a very important place, and it is not uninteresting to notice what has been done with it in other countries. In connection with steel, it should be remarked that many manufacturers claim to produce a particular metal, possessing special properties; under the name of cast-steel they sell a metal which is, in fact, almost peculiar to the works in which it is produced: if these assertions be accurate, there would appear to be comparatively little steel obtained directly by the Bessemer process, as nearly all must be put down as made in crucibles, and the result of peculiar mixtures of raw materials. Thus KRUPP states that to produce his 40-ton block the use of 1500 crucibles were required, and the Bochum Company and Messrs. PETIN and GAUDET have each their crucible steel. JOHN BROWN, of Sheffield, again, has a metal to which he gives the distinguishing name of the works, and calls it "Atlas metal," claiming for it a very exceptional quality. It must not be denied, however, that the Bessemer process has the merit of furnishing the market with an excellent metal, all makers availing themselves more or less of it, whilst Austria and Sweden have vigorously taken up the process, and exhibit Bessemer steel of incomparable quality. This tendency of appropriation, which has of itself nothing blameworthy, cannot but be profitable to the purchaser, to whom it offers well-known types, probably arises from the desire to shelter one's-self under the old reputation of cast-steel, and also to produce a material of which they might claim the invention. To a similar feeling may also be attributed the tendency manifested in smelting establishments to devote every energy to one special article, whether large or small, and thus escape the ruinous competition of the general market.

As an example, ASSAILLY may be referred to. This work claims priority in the production of steel small guns, and sends hundreds of thousands annually into the market, whilst CHATILLON lays itself out for the supply of some 10,000 tons of nails of various kinds, and with its *feuillards gironnes*, hoop-iron rolled eccentrically will hoop all the vats in the Gironde through, providing the coopers with hoops adapted, without further trouble, to the conical vat so generally used. In Belgium there are many works which have been conducted upon similar principles, and these are precisely the establishments which have made the greatest progress. There are many other French smelting-works which merit notice, such as those of Maubeuge, Ménans, Denain, Alais, Dietrich, of the Metallurgical Society of Ariège, of the Providence Company at Hautmont, and of Dupont and Dreyfuss for the special irons, and the group of Forges de Fourchambault, which exhibits wrought-iron and tubes of all diameters, cut in such a manner that the uniformity of thickness throughout may be at once seen, but enough has been said to show the position generally of the trade in France.

With regard to the METALLURGICAL PRODUCTIONS OF PRUSSIA, it will be remarked that, like France, Prussia has her great smelting-works, some noted for their iron and some for their steel. Among the numerous iron-producing works represented are those of Borsig, at Berlin; of the Phœnix Company, in Rhenish Prussia; and of the Hoerde Company, in Westphalia. BORSIG exhibits plates, springs, and tyres forged from a single ball, all being without weld. The balls in a crude state, as well as others which have been hammered and forged, weighing upwards of a ton, affords sufficient evidence of the quality of the material used. The samples appear to show a very homogeneous metal, and this opinion is corroborated by the fact that BROWN, of Sheffield, produces his celebrated armour-plates by a similar process to that of BORSIG. This mode of working—producing the article from a single mass of crude iron—is a great step in advance, since it entirely does away with the costly rolling and hammering, especially in the manufacture of plates. The PHŒNIX COMPANY, of Ruhrort, one of the largest establishments in Prussia, exhibit a fine collection of the various kinds of products they send into the market, from which the numerous products can be readily appreciated. The HOERDE WORKS have so long enjoyed the reputation of being the model works both for size and arrangements, and the products exhibited are well calculated to show the character of the work daily produced there; there are also shown some large pieces of T-iron, and some plates weighing nearly 3 tons. These works have for some time past been foremost in the attempt to resolve the problem of abolishing the use of wooden sleepers in the construction of railways, and there are some good specimens at the exhibition, showing the latest designs which they have introduced. Near these specimens of irons the Hoerde Company also exhibits the ores used in the works, and the pig-iron used in the manufacture of Bessemer steel, as well as specimens of the products thus obtained. There are springs, rails of the usual section, and about 15 feet long, in Bessemer steel; and steel tyres welded to iron in such a manner that even in the case of breakage the two metals will not separate from each other. The sheets and tin-plates of the DILLINGEN WORKS, the irons for construction purposes from the BURBACH, KŒNIGSHUETTE WORKS, and from STUMM, of Neunkirchen, the wire from the ROTHE ERDE WORKS, near Aix-la-Chapelle; and the wire in various forms, plain, coppered, zinced, and tinned, from KRIEG and TIEGLER'S at Wesel, from COSACK, and from HOBRECKER at Hamm; and the galvanised iron and tin-plates from BUDERUS at Neuwied, are all worthy of particular mention. The excellent quality of Prussian pig-iron is everywhere known to do full justice; it would be necessary to mention every firm in Westphalia and Silesia which appears in the list of exhibitors, but particular credit is due to the establishments of Dresler, of Siegen, and to the Coeln Musener Society, and the George Marienhütte, of Osnabruck.

PRACTICAL IRON MANUFACTURE—No. III.

[From the *Iron Trade Review.*]

RAILS.—The writer had intended to have written another and concluding article on the manufacture of plates, but circumstances have prevented him, and he will now pass on to rails. In the *Engineering* of July 12 is a paragraph, which mentions that 20,000 tons of Bessemer rails are given out for manufacture, at the price of 12*l.* 12s. at the works. Although the title of this paper is "Practical Iron Manufacture," a few words will be said on Bessemer steel.

What an innovation in rail making was that discovery of Bessemer's! The writer remembers going to Sheffield, with a few gentlemen interested in steel making, to witness a trial of Bessemer steel. It was in the early part of 1858. Bessemer had then just started his works at Sheffield. The piece to be manipulated on was a small ingot, which was to be tilted down to 1¼ inch square tool steel. The ingot was duly heated, and the tilting began under one of the old tail tilts A foot or 18 inches was brought down, and everything appeared to go as "merry as a marraige bell," when suddenly the piece flew into many pieces. Significant smiles passed over the faces of the Sheffielders: whilst Mr. Bessemer, with frantic eagerness, endeavoured to explain to the gentlemen present the cause of the disaster. Whether he succeeded in convincing the gentlemen that the imperfection could be remedied the writer does not know: but he imagined that Mr. Bessemer himself was in sickly doubt of the success of his persuasive arguments. Perhaps the feelings of the majority of the gentlemen present were not in favour of the experiment. The writer learned that they were not sanguine of the success of the process. No doubt they have lived to see that opinion, and many others, come to grief. One of the gentlemen, a leading manufacturer, and one who has been very successful in business, was an exception to those present in the matter of belief in the success of the invention; for on the way home he remarked that he was not sure of the utility of the process in application to tool steel, or steel for better classes of cutlery, or files, but there was a wider field than that open to the inventor, in the casting of heavy blocks of steel at a cheap figure, which might be manufactured into tyres, rails, shafts, gears, and other requisites;—and that has come to pass. What was the defect in the ingot alluded to which caused it to fly into many pieces? Has that defect been remedied? or does it exist now in the larger pieces, undiscovered, and of no great importance? The defect was a want of homogenousness in the quality and temper of the steel. This was, and still is, in a measure, to be expected. The Bessemer cupola is not so neat and well regulated a tool for conducting a fine chemical process, like the conversion of pig-iron into steel, as the small sealed pot which converts wrought-iron or blistered steel into a cast-steel ingot. The first method patented by Mr. Bessemer, of blowing the iron until it had been sufficiently decarbonised, was proved to be unsatisfactory, inasmuch as the quality was found to be irregular. Then the re-carbonisation by means of spiegeleisen, or other material, was resorted to, and found more efficient. Even now there is no substantial means of declaring when the steel is ready for running. And little affects the quality. An atmosphere impregnated with smoke has a marked effect upon it. For the finer purposes, then, for which steel is required we do not expect to hear that it has been wrought by the Bessemer process. But this paper has to do more especially with Bessemer steel as applied to rails, if it has aught to do with Bessemer steel at all. It has been stated, on the authority of inspectors, that there is considerable inequality in the temper of Bessemer steel. The rail is hard in one place and soft in another, comparatively; and one rail will altogether differ in that respect from another. It is conjectured, therefore, that the softer places and rails will wear more rapidly than the harder, and form hollows in the line or rail; and that this defect may necessitate renewal before they have accomplished the work which their cost warranted. Time will show if much importance can be attached to this defect in the manufacture of Bessemer steel. One thing is certain, that in the manufacture of this steel it is required that a pig-iron shall be used containing a large percentage of carbon, and one that shall be singularly free from what are usually called impurities—void of phosphorus and sulphur, with not too large a proportion of silicon. Only a few of the better brands of pig iron in this country are fit for the conversion into steel, amongst which is of course, the hematite pig. The following analysis of hematite pig, used for Bessemer steel, was printed in a former number, but it will not be out of the way to print it again here. It was run at the Cleator Moor furnaces:—

Combined graphite	4·44
Silicon	1·27
Sulphur	0·01
Phosphorus	0·09
Iron	94·21 = 100·02

Swedish iron, and the iron made in some parts of Germany from hematite and spathic ores, are also in request for making Bessemer steel.

Cleveland, alas, is not up to making Bessemer pig. Whether nitrate of soda is going to do the trick, or whether we must wait for the mystery to creep from the brain of sanguine and knowing young chemists who are supposed to be authorities in these matters, remains to be seen. When the finished iron manufacturers cannot get in this district a pig-iron which shall manufacture rails and bars of a quality equal to the general Staffordshire iron, it is not to be expected that they can manufacture Bessemer pig. Whilst blast-furnace plant, properly laid out, continues to be the best investment in Cleveland of the several departments of the iron trade, and while money is being reaped with high percentage on capital expended even at present prices, which are considered to be low, much improvements cannot be expected in the system of manufacture. The day may come when it will be found expedient to make an effort, and when that effort is made the matter will be accomplished. The system pursued in Staffordshire of washing the ores by lying out, and of selecting them for mixture, is one way of making good iron; and that might be done in Cleveland. Again, a commission might be appointed by the general body of furnace proprietors to make experiments, and to report as to the practicability of extracting the phosphorus during the progress of smelting. But it is hopeless to expect much while money can be so readily made in well laid out blast-furnace plant. And why money can be made in pig-iron making is very plain. It is because foundry iron can be made under 41s. 6d. in Cleveland, and in no other part of the world can this be done. If Bessemer industry were introduced into Cleveland, what district could compete in the manufacture of rails? In the first cost of wrought-iron rails as compared against steel ones, the value of the worn-out rails is to be considered. Wrought-iron rails, after use, will reach, say 4*l.* per ton. We do not know if any Bessemer rails are yet worn out, and if they are what price they may reach in the market, or, indeed, if there be any sale at all for them. Bessemer rails, no doubt, will flourish.

What the Bessemer invention has been, as compared to the ordinary steel manufacture, so will some process, not yet satisfactorily developed, be to the present mode of puddling for the reduction into wrought-iron. It would, indeed, be a boon if the heavy manual labour of puddling were superseded. A paper was read at the meeting of Mechanical Engineers, at Paris, by Mr. Menelaus, of the Dowlais Ironworks, on "Mechanical Puddling," and it was exceedingly interesting. The experiments made by the writer of that paper on so comprehensive a scale have turned out unsatisfactory. It is almost admitted that they are a failure. The reason given by Mr. Menelaus for his want of success is, that the lining of his furnace will not *stand;* and a poor quality of iron is produced. It is rotten and cold-short. And Mr. Menelaus adds that the latter is, after all, the principal drawback to deal with. It appears to the writer, after a careful perusal of Mr. Menelaus's paper, that he did not pay sufficient attention to the analysis of his fettling, and did not determine how long *it ought to last*—that is, with a view of making good iron. He says—"The titanic ore and the ganister, were found, on the whole, the best of the materials used for the lining of the puddling vessels, and they may be taken as types of the various substances tried." Again—"Some of the substances tried for lining, from which better results might have been expected, failed signally; in this class were bull dog and puddling ore." There are very good reasons why ganister should fail if anything like decent iron is required, and the same may be said of titanic ore; and this especially refers to any pig-iron which is liable to produce cold-shortness in the bar. Mr. Menelaus is not quite plain in what respect the different linings failed, whether by reason of the cold-short iron produced, or through the melting down of the lining. The ganister titanic ore, and bull dog, would produce cold-short iron. The two former are too resistive to the heat of a puddling furnace. They stand too long. The use of a fettling is not merely to preserve the plates—it has more to do than that—to purify and cleanse the iron; to be passive in the matter; or to do it positive harm if the fettling is not understood. A good fettling for the purpose, one to suit the Welsh iron, would be to tap off a mill furnace cinder bottom, Swedish magnetic ironstone, and best Ulverstone ore, in equal quantities, well pugged and ground, and formed into cakes by moulding, and then drying. The apparatus of Mr. Menelaus must be so arranged that the lining must be put in once for every three or four heats. This may be a difficult matter to do, but we should say not impracticable. If the fettling last too long, bad iron is the result. If the fettling come out too soon, it is mere waste. When the lining is meant to be rigid, such as ganister, the only means of cleansing the iron is by throwing some material in amongst the body of the iron, such as a manganese or spiegeleisen, with a little salt; but this would not be so satisfactory as the being able to put in a new lining of (say) 3 inches thick, about every three or four heats. If reference be made to the several analyses in the first of the articles of this series, it will be seen how important it is to have a good fettling often introduced into the puddling furnace. The bringing out the heat in a single ball, though spoken of as an advantage by Mr. Menelaus, is perhaps not unaccompanied by evil results. It is certain that every delay in ridding the ball of its cinder is hurtful to the quality. The iron is weak and brittle. A large ball such as the one from the rotatory puddling furnace, will necessarily be clumsy to handle and to "up end" at the hammer; and then whether the cinder is freely discharged from the centre of such a large mass of iron is doubtful. If the ball cannot be divided, perhaps it would be desirable to make the furnace less altogether. However, the public are much indebted to Mr. Menelaus for so frankly giving the result of his experience; and it is to be hoped that ultimately he may fully succeed with his furnace. Unfortunately for any experiments in the direction of cheapening the production of iron, one is met at every step with a stolid and heavy opposition on the part of the men. Every effort in the direction of progress suffers by an opposition so malignant that every spirit but the most energetic is deterred from the continuation of his efforts. This antagonism is, probably, not so marked in Wales as in England, and this must be attributed to the absence of unionism, and to the excessively low wages paid there as compared to English iron-making centres. The "pauper" labour of Wales gives the Welsh ironmaster a great advantage in the production of iron. More will be said on this head further on, and we will now describe the manufacture of ordinary rails.

A WELSH COMMON RAIL, DOUBLE HEADED.—The puddled bar is made from common cinder pig, all white, squeezed, and rolled into bars direct. The fettling used is a bit of fire-clay, or limestone, or indeed anything they can find handy, to throw into the furnace. The puddler makes seven heats a shift, charging 5 cwts. This white iron never boils, but just simmers a bit in the furnace. It is brought out and lapped up under the delightful old squeezers, and thrown from there into the "muck" rolls. What a suggestive name is that! And indeed a deal of muck comes between those rolls. You may see, if you take the trouble to stand opposite the forge rolls for five minutes, the bars being finished in all lengths, from 6 inches to 10 or 12 feet. The iron has a knack of tumbling to pieces in the rolls, and saves the cutting down shears a deal of work. The Welshman never cares much about quality. Quantity is his god. The puddled bar as above described is piled in layers, and heated in the mill furnaces, and rolled down into what is termed in Wales "rough down." Here, we call it No. 2 iron. Usually the size is 7½ in. by ⅞ in. This is used for tops and bottoms; and the common puddled bar, above described, is used as filling-up pieces, in sizes of 4½ inches by ¾ inch and 3 inches by ¾ inch, piled alternately to cross the joint. The pile is bloomed in square grooves, and is returned to the reheating furnaces, and then rolled off into rails. There can be no doubt that this makes a poor and miserable rail; and in places of moderate traffic we should imagine that from three to six months is about the time it will last before it is turned. This, no doubt, is considered good for trade, and the rail is as much as you can expect for the money. At some of the works in Wales better rails are made, for which, no doubt, a better price is got; and the favourite way of making this better quality is by refining mottled iron in the old refinery, and puddling this metal in eight or nine heats a shift of 5-cwt. charges. They thus treat it in the same way as the puddled bar before described. When making a flange rail the pile is made in precisely the same manner as the double-head, with the exception that the slab for the flange is made of the better quality mentioned above. They are seldom called upon to make a first-class rail in Wales, and when they do set about it, it is by means of refined iron. Very little grey pig is used, and they are not much used to boiling as a rule. The quantity of work turned in a given time is remarkable in Wales, as compared with Staffordshire or Cleveland. It is a common circumstance in a rail mill to average 80 tons a shift, and this has on several occasions run up to 100 tons and over. Aberdare is famous for the quantity turned out. In regular rail mills about 12 first heating, and 4 second heating furnaces are about the number in use. So far as the men are concerned, little pay and plenty of work seems to suit them. In Cleveland, unfortunately or not, as the case may be, high pay and little work seems to be the order of the day. Remarks will be offered on Welsh competition with Cleveland.

SYSTEM OF MAKING AN ORDINARY DOUBLE-HEADED RAIL AT A WORKS IN SOUTH YORKSHIRE.—One pig of hematite to three pigs of Cleveland, all grey, No 4; charge, 4½ cwts.—Fettling: Mill tap cinder and hematite ore. Made into fours, and cogged down into square lumps; these are ball furnaced, and rolled down into tops and bottoms 7 ins. by 1½ in. The iron is brought out moderately young, so as to present a fine steel fracture. The pile for the mill-furnace is made very long, quite 4 feet, and the filling up pieces are old rails, and small bars, and crop ends, so as to make a tight pile. These are heated in the mill furnace, and rolled off straight into rails. No re-heating. Four furnaces to the mill, and make about 20 to 25 tons a shift. They also roll the same rail by making the pile deeper, and shorter: and blooming it, take it back to re-heat. The latter system is no doubt the best. Both methods produce a rail far superior to the common Welsh rail.

AN ORDINARY CLEVELAND RAIL is made as follows:—Mottled and white iron is puddled and rolled down into tops and bottoms direct. The filling up is from old rails, puddled bars, and any short pieces of iron that can be filled in. The pile is bloomed and re-heated, after which it is rolled down into the rail. This only makes a washy rail; very little, if anything, superior to the Welsh one. There is a great deal of "muck" made in Cleveland as well as in Wales. The top and bottom being rolled off direct will not be strong, made as it is from mottled and white pig. The rail is hard, brittle, and weak. Rails of a much superior kind, though, are made in Cleveland; and the following was noticed as the mode of manufacture at a large works in the district—a works which, as a rule, turns out very good iron, and has a very good name:—

A GOOD CLEVELAND RAIL.—In the puddling, the mixture is one pig of hematite grey No. 4, and make up of Cleveland No. 4.—Fettling: Pottery mine, Swedish mine, hematite ore, or blue billy; brought out moderately young, and cogged down into lumps; ball furnaced, and rolled down into 7-in., or what the size may be, for tops and bottoms. The middle of the rail made up from old rails, puddled bars, and filling in pieces of scrap. This pile is hammered and bloomed at the same heat, then re-heated and rolled down into the rail. This makes a first-rate rail, one that will last out three of the poorer sort before described, and the extra cost of making will not exceed 20s. a ton.

It is customary in some works to make the top and bottom for a double-headed

rail from old rails and scrap iron. This is called a superior rail; but we think it is a great mistake. There will be a want of homogeneousness, and the rail will wear very unevenly. At a portion of the Stockton and Darlington line, between Newport and Middlesbrough, where the traffic is severe, it will be seen, on examination, how much the rails differ in wearing power. Some have been in over two years—these are few; some twelve months, some six, and some three; and a great many of the latter required turning, the top being all to pieces. The writer was informed by the platelayer that in the same batch of rails were all qualities. Some would last two years, and many not three months. This shows a radical defect in the manufacture. The best system is the puddled steel head and fibrous web. Care must be taken, though, in the mixture and manipulation, or the steel head will not weld soundly to the soft iron.

If it were not for the phosphorus in the Cleveland pig, no district could manufacture better iron. It produces a strong and powerful iron, with, unfortunately, a serious blemish. Not like the crockery cinder-pigs of Wales, of which you use about 23 to 24 cwt. to make a ton of puddled bar, but a sound iron which works to yield, but cursed with an element which the pig makers have as yet not succeeded in extracting. Probably they have never tried.

THE COMPETITION OF WALES AGAINST CLEVELAND.—What a happy state of mind the pig manufacturers of Cleveland must be in. They can make handsome profits even in a time like this. No district can compete with them. They can make foundry iron under 41s. 6d. at the works. Wales can make her precious cinder pigs at something like that figure, perhaps a little below it; but when she tries to make a grey iron, she is nowhere in cost. Her supply of blackband is meagre, and the "native mine" is limited and expensive; and thus her imports of Northampton and hematite ores are considerable, at a cost of 14s. and 20s. respectively. This is pleasant for Cleveland. She need only fear (if there is cause for fear) the competition of the several firms which make up the district. Coke is the bugbear. It has got up in price a little bit these last few years; but still matters for them are jolly.

But how is it with the finished iron makers? Can they compete with Wales in common rails and bars? To this the writer must say no, after a good deal of experience in both districts. We do not mean the better qualities, for which Cleveland has a rising trade (to be further increased, it is sincerely to be hoped), for in better qualities Cleveland will beat Wales in cost price, owing to a cheap grey iron and cheaper mixture; but in common iron made from the before mentioned cinder-pig she (Wales) holds the monopoly of cheapness in production. And why is this? It is because pig-iron is cheap; coal cheap (it will average at the different works in Wales about 4s. 6d.); labour cheap (at present the cost of labour in Wales on the ton of rails is about 17s. a ton against 30s. in Middlesbrough). The puddlers work seven heats of pig and eight heats of metal to our six. The puddler in the North never exceeds his six heats a shift. Thus coal, pig-iron, and wages low, and a larger quantity produced in a given time, the Welsh master has the best of it in the open markets just now. In Wales there are no local markets of any importance; whereas in the North there is in the several towns and districts a very tolerable demand for all classes of iron.

When the wages of this district are more on a par with what is paid in Wales, and when we can get our men to turn out as much work, and when speculators from Glasgow will have ceased to continue in their rotten speculations, times, no doubt, will be as jolly to the finished iron manufacturer as to the pig maker.

[To be continued.] J. A. J.

NEW TUNNELLING AND QUARRYING MACHINERY.

In the Supplement to the *Mining Journal*, a few weeks since, we puplished Mr. W. FOTHERGILL COOKE'S paper, descriptive of New Machinery for Cutting, Tunnelling, Quarrying, and Facing Slate, Stone, and Marbles, read the previous Wednesday at the Society of Arts. The following is the discussion which ensued:—

Mr. BOTTY said they were much indebted to Mr. Cooke for the very excellent paper to which they had listened, for to their Society anything which tended to economise labour and material must always be interesting. He had the pleasure of making a tour in North Wales in September last, when he had an opportunity of inspecting several of the slate quarries there. Some of these appeared, in his opinion, to be worked in a very slovenly manner. One thing he particularly noticed, which had been mentioned by Mr. Cooke—the enormous waste of slate, especially in blasting. Large masses were wasted by the system of quarring there adopted, and he apprehended, from the description of the machine, that a great saving might be made by its use.

Mr. R. G. LECKY had much pleasure in bearing his testimony to the value of the machines, having recently seen one at work. There were many points in it much to be admired, especially the facility for sharpening the tools, and the power of the saws to cut deeper than their semi-diameter, which was a great fault with common saws. He was able to speak to that point, because about 15 or 16 years ago he had helped to plan, construct, and erect what he believed was the largest slate saw ever made up to that time. It was for the Valentia quarries, and was capable of cutting 9 in. of Valentia slate, which was pretty hard. Working with two 3 ft. 6 in. saws on one axle, they were able to cut 9 in. slabs at the rate of about 5 ft. an hour, and this was considered pretty good work. He thought, therefore, that Mr. Cooke had spoken a little too depreciatingly of the working of toothed saws. These saws certainly lasted a very long time, for one pair had been at work for six months or more, and only require sharpening once a day. The blades were ¼ in. thick, and there was one-eighth set on each side, so that the breadth of the cut was half an inch. It was much easier to work these two saws than to work a single-bladed hand-saw. He believed these saws were still at work at Valentia. Hunter's saw, however, was a most efficient machine, and he was very much pleased with it.

Mr. C. F. VARLEY said that about two years ago he paid a visit to the neighbourhood which Mr. Cooke had described, and he had spent a considerable time in the quarries known as Lord Palmerston's, which he believed yielded the best slates to be found in that part of the world. The first thing which struck him was the mountains—not merely hills—of waste. It was something prodigious; in fact, he believed he was correct in saying that about one-ninth of the slate got out of the quarry was ever brought into the market in the form of slabs or roofing slates, and that under the most favourable circumstances, when they had obtained large and sound blocks, they never succeeded in making more than one-fourth of the material so extracted available for commercial purposes. The process of tunnelling, which Mr. Cooke had particularly alluded to, seemed a very important one. It was necessary to form tunnels through the slate to get from section to section, and as in so doing they undercut the mountain, it was requisite to leave strong pillars to support the superincumbent portion, and all this had to be done before getting at the slate. It was, therefore, evident that if this tunnel took such an enormous time to cut—Mr. Cooke had mentioned 10 yards a month—there must be a large amount of capital lying idle in such a quarry for a considerable time before any returns were made. Anything, therefore, which would quicken these preliminary operations must be very valuable, and he understood from Mr. Cooke that the tunnelling machine would do the work three and a half or four times as quickly as it could be done by the old method. The combination of the circular cutter and the under cutter, by which pieces of slate were brought out ready for immediate working, seemed also very valuable, and he had been informed that in this way rather more than one-half of the whole amount of slate taken from the quarry had been actually rendered available for the market. That alone showed the immense value of the machines which Messrs. Hunter and Cooke had already brought into successful operation. The photographs which were exhibited showed that several little difficulties which had presented themselves when he was in the neighbourhood had since been mastered, and he saw no reason why the machines should not meet with all the success which had been hoped for them, especially since the cutters could be made in so simple a manner, so rapidly, and at so trifling a cost. These little circular discs were nearly the only parts of the machine which underwent any serious wear and tear, and these were stamped out so quickly that the only parts of the machine likely to wear—the teeth of the saw—were rendered the cheapest to construct, and not only this, but they were so simply and easily taken out and replaced that it took only about ten seconds to remove a damaged one and substitute a new one, the cost being, he should imagine, a very small fraction of a penny. All this, too, could be done without withdrawing the machine from its work. That he considered one of the greatest improvements. The application of the cutting machinery to the working of the stone seemed, however, to his mined, even more important than that which he had referred to, the mere cutting out of the plate, as it superseded the necessity for the enormous amount of hand-labour now employed in cutting and dressing stone. There was another point of view also from which it seemed to him that the invention ought to receive the especial approval of the Society. For many years, especially under the presidency of the Prince Consort, great attention had been paid to improvements in buildings for the poorer classes, and also to familiarising the public eye with articles of artistic design. One of the specimens on the table, to which Mr. Cooke had not drawn attention, was a piece of a ridge-tile, or stone, and in that it would be seen that, simply by one tooth of the machine being placed rather more prominent than the others, an effect very similar to what was called engine-turning had been produced, an effect which could not be produced by hand, except at an immense cost. In the same way, it was evident that, by slightly varying the position of the tools, almost any design or moulding in stone might be produced. He believed that Mr. Cooke had done for stone that which was done many years ago for wood, and that material which before was of small value, but of costly manufacture, was now easy to be worked, and would, therefore, be produced in great abundance and at low cost; so that stone would begin to take the place of brick in very many instances.

Mr. COOKE, in reply to the questions and observations which had been addressed to him, said he feared the great waste from blasting would never be diminished in some of the great quarries. The floors were not so deep, however, as had been imagined: the deepest, with very few exceptions, were about 60 ft. In one or two instances, perhaps, the depth might be 90 ft. The practice which had been adopted there for some time was to bore a hole 14 or 15 ft. in depth and 2 in. or 2½ in. in diameter, and charge it with powder, explosive glycerine, or cotton, and so bring down an enormous mass of slate, which, perhaps, would take three months in removing. He had seen, at Mr. Assheton Smith's quarry, a mass of slate which had not been entirely removed at a second visit, four months later. With such a quantity falling such a height, of course an immense amount was damaged, and not more than one-ninth, or sometimes a tenth, was fit for the market. He believed the proprietors would do well to introduce these machines, and thus effect a great saving. They had sometimes sent him pieces to cut, and a short time since he received a block of about 4 tons, which he returned in about half an hour, cut into fine slabs. Nothing could have been made of it without the machine, as some parts were very hard, and there was no good cleavage. He was afraid, however, that the wasteful system would continue for some time in the large quarries, where the owners, being wealthy men, looked for a large and rapid return, although such a mode of procedure must tend to exhaust the material; and he believed that one quarry at Penrhyn was already causing the proprietor some anxiety. He had been much interested in hearing from Mr. Lecky of the Valentia saw, which was new to him, or he should certainly have referred to it in the paper. He would like to know the speed at which it worked. The ordinary speed of their small saws was 120 ft. to 130 ft. a minute.

Mr. LECKY said that the Valentia saw was driven at a speed of nine revolutions a minute, or about 108 ft.——Mr. COOKE said that their machines worked at only 45 ft. per minute. He believed the Valentia stone was very valuable, but that it was not a slate, and had no cleavage, being only valuable for slabs, and not for roofing slates.

Mr. LECKY said the stone was a true slate, and had a decided cleavage, though the softer portions would only cleave into very thick roofing slates. The slabs were cut with hand-saws.——Mr. COOKE said that appeared to be a slate which wore the saws very little, for at the Ffestiniog quarries he had seen a saw removed twice in a day to be sharpened, and had known one worn out in the course of a fortnight. The work done by the Valentia saws was very good, and although there would be more waste, the comparative cost of the machinery at starting would, probably, in that instance, be in favour of the saws. He considered the small disc tool a perfect masterpiece, and the cost of each would certainly be a small fraction of a farthing. The ornamental work to which Mr. Varley had called attention arose from an accident; one of the tools being rather larger than the others, every time it came round it made one of those curves. Of course no one could see that without seeing that the same thing might be turned to advantage, and there was no doubt that the tools could be so arranged as to produce on the stone every effect of engine turning.

Mr. BLACKIE observed that the cost of the machines had not been stated, or the cost of erecting them, and what was the percentage of wear and tear, which, he imagined, must be considerable. He should also like to know what power was used to drive them, and the amount of horse-power required for a large machine?

Mr. COOKE said that, in the case of one of the machines which had been in operation two or three years, it had not yet shown any symptons of wear and tear; it was difficult to form a calculation, but the part which seemed to wear most was the nut which worked the feed-screw; the dirt got in there and wore away the brass. The cost of the machines varied from 100*l.* to 1500*l.*; those were the two limits.——Mr. BLACKIE suggested that if cups were applied over the bearings and parts where dust was likely to fall it would save wear, and remarked that no information was given as to the temper of the tools, and whether water or any other liquid was used in cutting the stone. It appeared to him that, whatever might be the temper of the tools, if they were worked dry, the friction and consequent heat would be so great as very quickly to destroy them.

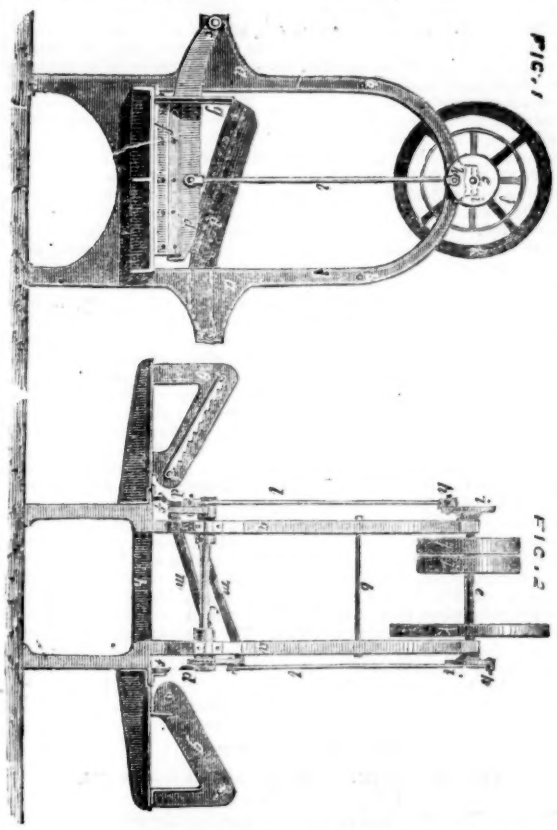
Mr. COOKE said the machines worked so slowly that unless when cutting something particularly hard, like quartz or iron pyrites, the tools did not heat in the slighest degree. On one occasion, in cutting through some iron pyrites, he had found the tools not only hot but actually melting. Such cases were very exceptional, and must be dealt with when they occurred. With the circular form of tool, it was easily turned round with the finger as it came up, so as to present a fresh edge, and each tool gave them three cuts before it was worn out, and the largest of these tools would not cost certainly more than a farthing. There was a great difference of opinion amongst the workmen in Wales as to the merits of dry or wet cutting; in some quarries, where there were a great many circular saws at work, the men liked to use water, and in others they did not. In his (Mr. Cooke's) quarries they invariably used water in tunnelling, both to keep the tools cool and to wash out the debris. They worked the double-tunnelling machine with a small turbine, and some of the water, before it reached the turbine, was sent through a tube into the cutting, so that the tools were kept quite cool, and he had seen them go in for a second cut without turning, and that in bad slate, where there was a good deal of iron pyrites. With regard to the temper, he had already mentioned that it varied according to the stone to be cut. They did not send slate tools to Newcastle to cut limestone; a very inferior tool would do that work. Nothing was worse to cut than sandstone or slate. The sandstone yielded too soon and ground the tool, and the slate also would always grind it. It would take a considerebly time to grind the hard edge of the tool off, but when that was gone it was soon finished. Only the day before a mason had been looking at the various specimens of work on the table, and he at once observed that a different tool would be required for each. Marble would very soon destroy the edge of a tool if used dry, but if abundance of water were used nothing cut more easily, and a fine polish was left; it was like turning brass with oil, or iron with water, if they were turned dry the tool would very soon be spoiled.

Mr. BLACKIE suggested that the powdered stone which resulted from the cutting would be valuable for mixing with lime, in parts of the country where sand was not easily obtainable.——Mr. COOKE said this was a very good suggestion.

The CHAIRMAN then moved that a cordial vote of thanks be given to Mr. Cooke for the paper which he had brought before them. The machinery he had described seemed likely to prevent the waste of material of considerable value, and was certainly most ingenious.——The vote of thanks was then passed.

Mr. Cooke illustrated the action of his machinery by a working model, and a large number of specimens, showing the effect of the various tools described.

MACHINE FOR DRESSING SLATES.



In the accompanying engraving we show a duplex machine for dressing slates, which has been invented and patented by Messrs. Wreh and Hopkinson, engineers, of Manchester, and by means of which time, labour, and space are economised. Fig. 1 is a front and fig. 2 a side elevation of the improved duplex machine: *a a* are strong cast-iron frames, connected together by the stays *b b*; *c c* are the axles of the radial cutting knives *d d*, and *e* is the driving shaft. The axles *c* and the shaft *e* are supported in bearing in the frames *a a*; the stationary knives *f f*, and the gauges *g g*, for determining the sizes of the slates, are made in the usual manner, and secured at each side of the frames *a a*. The axles *c* are placed at opposite sides of the machine, and the crank pins *h h*, by which the cutting knives are worked, are fixed in the discs *i i*, keyed on the driving shaft *e*, which is provided with fast and loose pulleys *j j*, and with a fly-wheel *k*. The crank pins *h h* are connected to the cutting knives by the links *l l*, and they are so placed that the cutting knives move up and down alternately, in order that they may act in succession on the slates at the opposite sides of the machine. The cutting knives are strengthened by the diagonal stays *m m*, which are connected to the axles *c c*, and to the outer end of the cutting knives, and are parallel to each other. By this arrangement a duplex machine is kept within the width of a single machine, and considerable space is thereby economised.—*Mechanics' Magazine.*

CWT-Y-BUGAIL SLATE QUARRY.—This slate quarry is situated about two miles from the village of Festiniog, and about the same distance from Penmachno. It was started by a company some 20 years ago, but from want of capital the work done was but limited, and during that period it was stopped several times. A year or two ago, however, the property came into the possession of the present company, and since then the quarry has been worked with great judgment, skill, and enterprise. A great many tunnels have been driven and openings made. The quarry includes two distinct veins; one on the Festiniog side of the mountain, and which is called the black vein; and the other on the Penmachno side called the front vein. About six weeks ago a steam-crane was placed at the top of the opening in the back vein for the purpose of drawing out the refuse matter. The crane was manufactured by Chaplin and Co., Glasgow, and it was awarded a prize at the International Exhibition in 1862. The depth from which it raises the wagons at present in some 18 yards, and it takes only a minute to accomplish it though the weight of the load is often (exclusive of the waggon) above three tons. It is one of the most efficient and useful steam cranes we know of, and it requires comparatively but a small quantity of coals. The last-mentioned vein is so extensive that no one knows its real thickness, and the quality of the rock is remarkably good. The other vein—the front—though narrow, is very solid and pure, and therefore is valuable. From this it will be seen that it is only a question of time for this property to become one of the most profitable undertakings in the locality. A large number of slates and slabs are being made daily, the excellent quality of which is a certain test of the value and quality of the rock.—*North Wales Chronicle.*

FOREIGN MINING AND METALLURGY.

The French siderurgical markets, after a brief rally, have again subsided into a state of depression. The crisis through which metallurgical industry is passing appears to be common to all the producing centres, but the French seem to consider that they have suffered the most. The numerous establishments which form the French groups carry on, in fact, an inveterate competition on the various markets of the interior, on which orders are only obtained by concessions. They have also to deal with foreign competition, which keeps them off foreign markets. On the Paris market the great establishments which furnish coke-made iron are carrying on a competition from which surprising prices often result; in the South the great Creusot establishment makes concessions which enable it to absorb all the orders which present themselves; and in the East the same Creusot shares the demand with works in the Moselle group. The state of affairs is thus rendered a very difficult one for secondary establishments which do not dispose a large capital, or which are situated at some distance from the natural elements of production. The report presented to the Marseilles Docks and Warehouses Company states that the quantity of goods dealt with in the year 1866 was 379,066 tons. To this total iron minerals contributed 95,261 tons; and coal 186,445 tons. The directors state that the movements of goods in 1866 presented an increase of 73,737 tons, as compared with 1865; but the nett profits realised present no augmentation, as the additional business done arose almost wholly from the larger quantity of coal and minerals received, and which leave only a very limited profit. The Rive-de-Gier Collieries Company will pay, Oct. 16, a dividend of 3*s.* 3*d.* per share on account, in respect of the first half of 1867. The Meurchin (Pas-de-Calais) Collieries Company is now paying the dividend for the past exercise, or 3*l.* 4*s.* per share. Meetings are announced as follows:—Roujan Mines Company, Aug. 26, at Paris; Mouzala Mines Company, Aug. 31, at Paris; St. Eiot Collieries and Railway Company (Puy-de-Dome), Sept. 5, at Paris; and Styring Collieries Company, Sept. 28, at Paris.

The results of the adjudication of the rails required for the Dutch State railways have occasioned some excitement among Belgian industrials. It had been hoped that contracts for these two lots of 5000 tons each would have supplied work to Belgian establishments, and in this hope considerable reductions have been made in prices; but the anticipated and hoped-for result has not been attained, and for the second time this year English firms have carried off orders which were keenly competed for by Belgian works. No symptom of improvement has appeared in Belgian metallurgy; affairs appear to be scarce and difficult, old orders are exhausted without being replaced by new ones, and more than one establishment is said to be approaching a period when it will be wholly without work. A certain movement of Belgian iron towards Switzerland has been remarked of late. MM. de Dorlodot, of Acoz (Belgium), have forwarded iron to Bâle, although the cost of transport between the two points amounts to nearly 1*l.* 7*s.* per ton. Meetings are announced as follows:—Providence Forges Company, Aug. 26, at Marchienne; Val-Benoit Ironworks Company, Aug. 27, at the Val-Benoit; Augsburg Machine Construction Company, Aug. 28, at Strasburg; Bois Collieries Company, Sept. 3, at Quaregnon; United Proprietors Collieries Company, Sept. 10, at Marchienne-au-Pont; Longterne-Ferrand Colliery Company, Sept. 12, at Elouges; and Sars-Longchamps and Bouvy Collieries Company, Oct. 31, at St. Vaast. It appears that the Belgian State Railways carried 1,420,007 tons of heavy goods last year, more than in 1865. To this increase coke contributed 42,536 tons; coal and briquettes, 921,645 tons; and minerals, 252,347 tons. It appears that the Belgian General Bank has undertaken, in connection with the Coal Basins of the Hainaut Railway Company, the construction of a network of vicinal railways in Brabant. This new network of lines will have a total development of 129¾ miles, and will be connected with all the railway lines now existing in the district.

A transport service, organised from Port-Said to Suez by the Suez Canal Company, appears to have already acquired a certain importance. The delivery of the necessary plant (tugs, sloops, &c.) is completed, and the receipts acquired during the first six months of this year amounted to 21,055*l.*; the weight of goods carried during the same period was 9506 tons, and the number of passengers conveyed was 20,132. The business done during the last two months shows a considerable increase. The Peninsular and Oriental Steam Navigation Company is said to be contemplating the dispatch of coal to Suez by this route. The Bombay and Bengal Steam Navigation Company has also had negociations of late with the Suez Canal Company.

Not only have Belgian metallurgists and capitalists to contend with much current depression of business, but they are also suffering grievously from the depreciation of dubious foreign railway obligations, eagerly taken in order to obtain contracts. The number of these obligations is roughly calculated as follows:—Northern of Spain, 100,000; Ciudad Real and Badajoz, 100,000; Granollers and San Juan de las Abadesas, 20,000; Cordova and Malaga, 12,000; Cordova and Seville, 10,000; Leghorn, 60,000; Central Tuscany, 20,000; South Italian, 35,000; and Rutschuk and Varna, 130,000: total, 487,000. The loss sustained on these obligations, comparing their present value with the rate at which they were issued, is calculated at 2,000,000*l.*

Attention has been frequently called of late to the efforts made by the Emperor Napoleon to increase the extraction of coal in France. Those efforts have been so far successful that 13,000,000 to 14,000,000 tons of coal will, probably, be raised this year from the French soil; but, after all, this total bears a pitiful proportion to the quantity of coal raised annually in England. In 1866 the quantity of coal made available for consumption in Great Britain was 101,630,543 tons, while in 1856 the corresponding total was 66,645,450 tons. We have thus an advance in the English coal extraction in 10 years of 34,985,093 tons, the very increase in the English production being more than double the whole quantity raised in France. If Sir Robert Peel's remark were correct—and we are inclined to think that it was a sagacious one—that the country which has the most coal would have the most power, England must have attained an unprecedented development of national greatness.

Advices from Havre indicate more stability in the price of copper at that port, and also induce an impression of a revival of activity in the article. For 20 tons of disposable Chilian, in bars, 69*l.* 10*s.* per ton has been paid (Paris conditions); since then the tone of the article has been a little firmer. On the Paris and Marseilles markets copper remains quiet, and prices are almost nominal. There has been no sensible change in the tone of the German markets. That of the Dutch tin markets has been more feeble; at Amsterdam and Rotterdam few affairs have been concluded: the sale is noted of 700 blocks of Banca at 52½ fls., 500 ditto at 52¼ fls., and one lot of 500 blocks of Billiton at 51½ fls. Affairs in tin have been quiet on the French and German markets; price sgenerally display little change. Lead remains in much the same state; the demand continues restricted, but as the supplies on the principal markets are of little importance, former prices have been well maintained. Advices from Breslau with regard to zinc present only a secondary interest; nothing has occurred to change the aspect of the market, and no transaction worth mentioning has been recorded. On the other hand, at Hamburg zinc has been more sought after, and would give rise to some important transactions but for the high pretensions of holders. Affairs remain without activity at Paris; rough Silesian remains nominally at 21*l.* 12*s.*, and zinc from other sources at 21*l.* per ton.

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